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VOLUME IV

VANDERBURGH COUNTY, INDIANA AND HENDERSON AND DAVIESS COUNTIES, KENTUCKY

MARCH 1977
FINAL REPORT

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION V
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CHICAGO, ILLINOIS 60604

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By

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ABBREVIATIONS

AADT - Annual Average Daily Traffic
AQMA - Air Quality Maintenance Area
AQMP - Air Quality Maintenance Plan
CDM - Climatological Dispersion Model
EF - Emission Factor
EGF - Emission Growth Factor
EIS - Emission Inventory Subsystem
EUTS - Evansville Urban Transportation Study
IAPCD - Indiana Air Pollution Control Division
KDAP - Kentucky Division of Air Pollution
LTO - Landing and Take Off Cycle
NADB - National Air Data Branch, USEPA
NEDS - National Emissions Data System
NSPS - New Source Performance Standard(s)
SCC - Source Classification Code
SIC - Standard Industrial Classification
SIP - State Implementation Plan
SO_2 - Sulfur Dioxide
TPY - Tons Per Year
TSP - Total Suspended Particulates - for fugitive dust particles emissions are reported for particles $<30\mu m$
UTM - Universal Trans Mercator
VMT - Vehicle-Miles Traveled

INTRODUCTION

This report documents a study to update and project air pollutant emissions inventories for Vanderburgh, Daviess, and Henderson Counties. The pollutants studied were total suspended particulates (TSP) and sulfur dioxide (SO_2). The study was divided into an area sources segment and a point sources segment. The area source segment consisted of two parts: the baseyear 1974 inventory and projections for 1975, 1980, and 1985. The area source baseyear inventory is reported in Section 2.0. The projected inventories are described in Section 3.0. The goal of the point sources segment was to project 1975, 1980, and 1985 emissions from an existing NEDS-format inventory. Section 1.0 describes the methods and results for the point source projections. Finally, both the point and area sources inventories were converted into input format for the Climatological Dispersion Model (CDM). This conversion is described in Section 4.0. The following section summarizes the inventory results for both point and area sources.

SUMMARY

The results of this project can be summarized as follows. For area sources, both a baseyear 1974 inventory and projections were accomplished. The inventories encompassed some 24 categories. Each category was also gridded below the county level. The county emissions inventories by category are shown in the following tables. The gridded emissions were submitted to the regional office under a separate cover.

For point source projections of 1975, 1980, and 1985 particulate and SO_2 emissions were accomplished. The existing point source file for each county was used as the basis. Projections were performed for each stack using industry-supplied growth estimates and OBERS factors. The projected county point source emissions are summarized in the following table.

VANDERBURGH COUNTY AREA SOURCES INVENTORY AND PROJECTIONS

(TONS)

	1974		1975		1980		1985	
	TSP	SO_2	TSP	SO_2	TSP	SO_2	TSP	SO_2
Stationary Sources								
Residential	123	491	124	494	129	517	131	522
Com./Inst.	56	300	56	302	59	316	60	319
Industrial	2677	2921	2718	2965	2969	3239	3108	3391
Highway Vehicles	665	255	643	255	529	252	476	224
Off Highway Sources								
Railroads	43	97	43	97	43	97	43	97
Vessels	11	63	11	63	11	63	11	63
Aircraft	23	20	23	20	23	20	23	20
Farm Equipment	11	7	11	7	11	7	11	7
Construction	36	37	36	37	36	37	36	37
Miscellaneous	34	25	34	25	34	25	34	25
Incineration								
Residential	21	3	21	3	22	3	22	3
Com./Inst.	14	4	14	4	14	5	15	5
Industrial	8	3	8	3	9	3	9	3
Open Burning								
Residential	10	1	10	1	11	1	11	1
Com./Inst.	1	<1	1	<1	1	<1	1	<1
Industrial	2	<1	2	<1	2	<1	2	<1
Fugitive Dust								
Ag. Tilling	2512	0	2512	0	2512	0	2512	0
Construction	408	0	408	0	408	0	408	0
Unpaved Roads	636	0	636	0	636	0	636	0
Paved Roads	1107	0	1107	0	1139	0	1176	0
Wind Blown	215	0	215	0	215	0	215	0
Process Losses	0	0	0	0	0	0	0	0
Structural Fires	56	<1	56	<1	59	<1	60	<1
Forest Fires	<1	<1	<1	<1	<1	<1	<1	<1
Grand Total	8669	4227	8689	4276	8872	4585	9000	4717

DAVIESS COUNTY AREA SOURCES INVENTORY AND PROJECTIONS

(TONS)

	1974		1975		1980		1985	
	TSP	SO_2	TSP	SO_2	TSP	SO_2	TSP	SO_2
Stationary Sources								
Residential	1283	7964	1310	8131	1447	8983	1521	9445
Com./Inst.	1329	3125	1357	3191	1499	3525	1576	3706
Industrial	33	257	34	263	38	294	42	325
Highway Vehicles	315	121	315	125	292	126	291	137
Off Highway Sources								
Railroads	24	54	24	54	24	54	24	54
Vessels	8	48	8	48	8	48	8	48
Aircraft	10	4	10	4	10	4	10	4
Farm Equipment	21	15	21	15	21	15	21	15
Construction	29	30	29	30	29	30	29	30
Miscellaneous	16	12	16	12	16	12	16	12
Incineration								
Residential	54	8	55	9	61	10	64	10
Com./Inst.	17	5	17	5	19	6	20	6
Industrial	11	3	11	4	12	4	14	4
Open Burning								
Residential	40	3	41	3	47	3	47	3
Com./Inst.	4	<1	4	<1	5	<1	5	<1
Industrial	11	1	12	1	14	1	13	1
Fugitive Dust								
Ag. Tilling	4563	0	4563	0	4563	0	4563	0
Construction	160	0	160	0	160	0	160	0
Unpaved Roads	2680	0	2680	0	2680	0	2680	0
Paved Roads	525	0	543	0	632	0	720	0
Windblown	501	0	501	0	501	0	501	0
Process Losses	49	44	49	44	49	44	49	44
Structural Fires	50	<1	52	<1	57	<1	60	<1
Forest Fires	1	<1	1	<1	1	<1	1	<1
Grand Total	11734	11694	11813	11939	12185	13163	12435	13844

HENDERSON COUNTY AREA SOURCES INVENTORY AND PROJECTIONS

(TONS)

	1974		1975		1980		1985	
	TSP	SO_2	TSP	SO_2	TSP	SO_2	TSP	SO_2
Stationary Sources								
Residential	20	28	20	29	21	31	22	32
Com./Inst.	6	29	6	29	7	31	26	37
Industrial	12	92	12	93	13	101	14	108
Highway Vehicles	209	80	208	82	191	83	189	89
Off Highway Sources								
Railroads	11	25	11	25	11	25	11	25
Vessels	33	189	33	189	33	189	33	189
Aircraft	1	1	1	1	1	1	1	1
Farm Equipment	27	19	27	19	27	19	27	19
Construction	4	4	4	4	4	4	4	4
Miscellaneous	7	6	7	6	7	6	7	6
Incineration								
Residential	24	4	25	4	26	4	28	4
Com./Inst.	8	2	8	2	8	3	9	3
Industrial	3	1	3	1	3	1	3	1
Open Burning								
Residential	15	1	15	1	17	1	18	1
Com./Inst.	2	<1	2	<1	2	<1	2	<1
Industrial	1	<1	1	<1	1	<1	1	<1
Fugitive Dust								
Ag. Tilling	4214	0	4214	0	4214	0	4214	0
Construction	2	0	2	0	2	0	2	0
Unpaved Roads	4450	0	4450	0	4450	0	4450	0
Paved Roads	345	0	356	0	411	0	466	0
Windblown	389	0	389	0	389	0	389	0
Process Losses	38	0	38	0	38	0	38	0
Structural Fires	16	<1	17	<1	18	<1	19	<1
Forest Fires	<1	<1	<1	<1	<1	<1	<1	<1
Grand Total	9837	481	9849	485	9894	499	9973	529

COUNTY SUMMARY OF POINT SOURCE

PROJECTED EMISSIONS

(Tons)

	1975		1980		1985	
	TSP	SO_2	TSP	SO_2	TSP	SO_2
Vanderburgh	655	4,964	814	6,560	806	6,485
Daviess	3,540	59,981	3,681	67,856	4,453	78,725
Henderson	1,381	8,317	1,423	6,784	1,520	7,094

RECOMMENDATIONS

For several point source facilities in Daviess and Henderson Counties, OBERS growth factors were used because no industry-specific estimates were available. It is recommended that these industries be contacted again for more accurate projections of future plant activity.

The area source fuel surveys for each county had various short-comings. Therefore, NABD county reports were used for several categories. It is recommended that these estimates be verified by additional contact with fuel dealers and that agency small source permit files be updated to include all commercial/institutional and industrial coal boilers.

It is also recommended that the fugitive dust emission estimates not be construed to have the same statistical certainty as the other area source categories. Most of the sources are site-specific, and the emission factors are inadequate.

1.0 POINT SOURCE PROJECTIONS

The purpose of this chapter is to describe the procedures used and results obtained for the point source emission projections in Vanderburgh County, Indiana, and Henderson and Daviess Counties, Kentucky. The first step in the analysis was to gather data for each point source which could be identified. This activity is described in Section 1.2. The second step in the analysis was to prepare a detailed methodology which could be used to project particulate and sulfur dioxide emissions for each point source. The resulting methodology is discussed in Section 1.3. The third step was to transform the data described in Section 1.2 into a form which could be used within the projec- methodology. For Vanderburgh County, calculations were performed by computer as a part of the analysis of eleven counties in Indiana. The inputs to this program for Vanderburgh County are described in Appendix C. The calculations for Henderson and Daviess Counties were accomplished manually. The results of these procedures are estimated particulate and sulfur dioxide emissions for each point source in each county for the years 1975, 1980 and 1985. These emission estimates are shown in Section 1.1.

1.1 Projected Point Source Emissions

1.1.1 Existing Sources

This section describes the results of the emission projections on a stack-by-stack basis. Data was gathered by the methods described in Section 1.2 for each process which the 1974 NEDS data base reported as a point source. This data was analyzed by the procedures described in Section 1.3. The result of this procedure was a projected particulate and SO_2

emission rate (in tons per year) for each source existing in 1974 for the years 1975, 1980, and 1985. These emission projections reflect a consideration of process growth, emission control equipment, and state and federal regulations. Compliance with all regulations is assumed. A listing of these projections for Vanderburgh, Henderson, and Daviess Counties are shown in Table 1-1, 1-2, and 1-3, respectively. These emissions have been rounded off to the nearest ton per year with any emissions less than 0.5 ton per year being reported as zero. The listing includes the following sources:

1) Any source in the 1974 NEDS for which growth data was received, whether or not there were any particulate or SO_2 emissions projected.

2) Any source in the 1974 NEDS for which no plant specific growth data was available but did have particulate and/or SO_2 emissions reported in 1974.

The listing for Vanderburgh County excludes sources reporting no particulate and/or SO_2 emissions in 1974 and having no plant-specific growth data. The listings for Henderson and Daviess Counties include all points in the 1974 NEDS data.

TABLE 1-1. PROJECTED PARTICULATE AND SULFUR DIOXIDE EMISSIONS AT EXISTING PLANTS - VANDERBURGH COUNTY

COUNTY NUMBER	PLANT NUMBER	PT, NO.	1975 PARTICULATE EMISSIONS (TPY)	1975 SO2 EMISSIONS (TPY)	1980 PARTICULATE EMISSIONS (TPY)	1980 SO2 EMISSIONS (TPY)	1985 PARTICULATE EMISSIONS (TPY)	1985 SO2 EMISSIONS (TPY)
4220	1	1	0	0	0	0	0	0
	1	2	0	0	0	0	0	0
	1	3	0	0	0	0	0	0
	1	4	0	0	0	0	0	0
	1	5	2	0	1	0	1	0
	1	6	2	0	1	0	1	0
	1	7	3	0	1	0	2	0
	1	8	3	0	1	0	2	0
	2	1	9	332	11	376	11	376
	2	2	11	397	10	353	10	353
	2	3	17	617	19	661	19	661
	2	4	17	618	19	662	19	662
	2	5	0	0	0	0	0	0
	3	1	3	41	3	44	3	49
	3	2	0	0	0	0	0	0
	3	3	0	0	0	0	0	0
	4	1	18	207	18	207	18	207
	4	2	1	24	1	24	1	24
	5	1	14	98	7	49	3	21
	5	2	14	99	7	49	3	21

TABLE 1-1. (Cont'd)

COUNTY NUMBER	PLANT NUMBER	PT. NO.	1975 PARTICULATE EMISSIONS (TPY)	1975 SO2 EMISSIONS (TPY)	1980 PARTICULATE EMISSIONS (TPY)	1980 SO2 EMISSIONS (TPY)	1985 PARTICULATE EMISSIONS (TPY)	1985 SO2 EMISSIONS (TPY)
4220	5	3	14	99	7	49	3	21
	5	4	1	2	3	8	3	8
	6	1	0	0	0	0	0	0
	7	1	1	0	1	0	1	0
	8	1	0	0	0	0	0	0
	9	1	14	208	14	208	14	208
	9	2	1	5	1	5	1	5
	10	1	0	0	0	0	0	0
	11	1	5	0	5	0	6	0
	12	1	0	0	0	0	0	0
	13	1	1	0	1	0	1	0
	14	1	0	0	0	0	0	0
	15	1	18	95	18	95	18	95
	15	2	35	189	35	189	35	189
	15	3	35	189	35	189	35	189
	16	1	0	0	0	0	0	0
	18	1	0	0	0	0	0	0
	18	2	1	0	1	0	2	0
	19	1	19	415	19	415	19	415
	19	2	2	30	2	30	2	30

TABLE 1-1. (Cont'd)

COUNTY NUMBER	PLANT NUMBER	PT. NO.	1975 PARTICULATE EMISSIONS (TPY)	1975 SO2 EMISSIONS (TPY)	1980 PARTICULATE EMISSIONS (TPY)	1980 SO2 EMISSIONS (TPY)	1985 PARTICULATE EMISSIONS (TPY)	1985 SO2 EMISSIONS (TPY)
4220	19	3	2	26	2	26	2	26
	21	1	0	0	0	0	0	0
	21	2	0	0	0	0	0	0
	21	3	0	0	0	0	0	0
	22	1	55	96	97	639	97	639
	22	2	59	103	106	702	106	702
	22	3	64	426	119	788	119	788
	22	4	3	33	3	33	3	33
	22	5	0	0	0	0	0	0
	22	6	0	0	0	0	0	0
	22	7	0	0	0	0	0	0
	22	8	0	0	0	0	0	0
	22	9	0	0	0	0	0	0
	22	10	0	0	0	0	0	0
	23	1	88	381	110	476	110	476
	23	2	60	199	75	249	75	249
	23	3	0	0	0	0	0	0
	23	4	0	0	0	0	0	0
	23	5	0	0	0	0	0	0
	24	1	5	30	6	35	6	39

TABLE 1-1. (Cont'd)

COUNTY NUMBER	PLANT NUMBER	PT. NO.	1975 PARTICULATE EMISSIONS (TPY)	1975 SO2 EMISSIONS (TPY)	1980 PARTICULATE EMISSIONS (TPY)	1980 SO2 EMISSIONS (TPY)	1985 PARTICULATE EMISSIONS (TPY)	1985 SO2 EMISSIONS (TPY)
4220	25	1	0	0	0	0	0	0
	26	1	0	0	0	0	0	0
	31	1	3	0	3	0	3	0
	31	2	2	7	2	7	2	7
	31	3	0	0	0	0	0	0
	31	4	0	0	0	0	0	0
	31	5	3	0	3	0	3	0
	32	1	4	0	4	0	4	0
	32	2	0	0	0	0	0	0
	32	3	2	0	2	0	2	0
	32	4	2	0	2	0	2	0
	32	5	10	0	10	0	10	0
	32	6	1	0	1	0	1	0
	32	7	4	0	4	0	4	0
	32	8	10	0	10	0	10	0
	33	1	17	0	16	0	16	0
	33	2	0	0	0	0	0	0
	33	3	0	0	0	0	0	0
	33	4	1	0	1	0	1	0

TABLE 1-2. PROJECTED PARTICULATE AND SULFUR DIOXIDE EMISSIONS AT EXISTING PLANTS - HENDERSON COUNTY

COUNTY NUMBER	PLANT NUMBER	PT. NO.	1975 PARTICULATE EMISSIONS (TPY)	1975 SO2 EMISSIONS (TPY)	1980 PARTICULATE EMISSIONS (TPY)	1980 SO2 EMISSIONS (TPY)	1985 PARTICULATE EMISSIONS (TPY)	1985 SO2 EMISSIONS (TPY)
	0001	01	3	0	3	0	4	0
		02	20	0	22	0	24	0
	0002	01	0	0	0	0	0	0
		02	7	0	7	0	7	0
		03	5	0	5	0	5	0
	0003	01	2	0	2	0	2	0
		02	2	0	2	0	2	0
		03	14	0	14	0	14	0
	0005	01	0	0	0	0	0	0
	0007	01	0	0	0	0	0	0
	0008	01	0	0	0	0	0	0
		02	0	0	0	0	0	0
		03	0	0	0	0	0	0
	0010	01	0	0	0	0	0	0
		02	9	0	9	0	10	0

TABLE 1-2. (Cont'd)

COUNTY NUMBER	PLANT NUMBER	PT. NO.	1975 PARTICULATE EMISSIONS (TPY)	1975 SO2 EMISSIONS (TPY)	1980 PARTICULATE EMISSIONS (TPY)	1980 SO2 EMISSIONS (TPY)	1985 PARTICULATE EMISSIONS (TPY)	1985 SO2 EMISSIONS (TPY)
	0011	01	0	0	0	0	0	0
		02	0	0	0	0	0	0
		03	0	0	0	0	0	0
		04	0	0	0	0	0	0
		05	0	0	0	0	0	0
		06	0	0	0	0	0	0
	0012	01	77	1938	60	1518	60	1518
		02	139	4199	93	2810	93	2810
	0014	01	0	0	0	0	0	0
		02	4	0	5	0	6	0
		03	4	0	5	0	6	0
		04	2	0	3	0	3	0
		10	3	1	4	1	4	1
		11	0	1	1	0	1	0
	0015	01	16	0	15	0	13	0
		02	53	0	60	0	66	0
	0016	01	1	0	1	0	1	0
		02	53	0	60	0	66	0

TABLE 1-2. (Cont'd)

COUNTY NUMBER	PLANT NUMBER	PT. NO.	1975 PARTICULATE EMISSIONS (TPY)	1975 SO2 EMISSIONS (TPY)	1980 PARTICULATE EMISSIONS (TPY)	1980 SO2 EMISSIONS (TPY)	1985 PARTICULATE EMISSIONS (TPY)	1985 SO2 EMISSIONS (TPY)
	0016	03	0	0	0	0	0	0
		04	0	0	0	0	0	0
		05	6	0	5	0	5	0
		06	0	0	0	0	0	0
		08	0	0	0	0	0	0
	0017	01	0	0	0	0	0	0
	0018	01	270	0	270	0	270	0
		02	4	0	4	0	4	0
	0019	01	0	0	0	0	0	0
		02	1	0	1	0	1	0
		03	0	0	0	0	0	0
		04	20	0	22	0	24	0
	0020	01	2	0	2	0	2	0
		02	2	0	2	0	2	0
		03	1	0	1	0	1	0
		08	2	0	2	0	2	0
		09	0	0	0	0	0	0
	0021	01	0	0	0	0	0	0
		02	0	0	0	0	0	0

TABLE 1-2. (Cont'd)

COUNTY NUMBER	PLANT NUMBER	PT. NO.	1975 PARTICULATE EMISSIONS (TPY)	1975 SO2 EMISSIONS (TPY)	1980 PARTICULATE EMISSIONS (TPY)	1980 SO2 EMISSIONS (TPY)	1985 PARTICULATE EMISSIONS (TPY)	1985 SO2 EMISSIONS (TPY)
	0021	03	20	0	25	0	25	0
		04	21	0	25	0	25	0
		05	20	0	25	0	25	0
		06	4	0	4	0	4	0
		07	0	0	0	0	0	0
		08	0	0	0	0	0	0
		09	2	0	2	0	2	0
		10	2	0	2	0	2	0
		11	9	0	9	0	9	0
		12	0	0	0	0	0	0
		13	0	0	0	0	0	0
		14	2	0	3	0	3	0
	0024	01	0	0	0	0	0	0
		02	0	0	0	0	0	0
		03	10	0	10	0	10	0
		04	1	0	1	0	1	0
		05	0	0	0	0	0	0
	0025	01	3	18	3	20	3	20
		02	2	1	2	1	2	1
		03	0	0	0	0	0	0
		04	0	0	0	0	0	0
		05	0	0	0	0	0	0

TABLE 1-2. (Cont'd)

COUNTY NUMBER	PLANT NUMBER	PT. NO.	1975 PARTICULATE EMISSIONS (TPY)	1975 SO2 EMISSIONS (TPY)	1980 PARTICULATE EMISSIONS (TPY)	1980 SO2 EMISSIONS (TPY)	1985 PARTICULATE EMISSIONS (TPY)	1985 SO2 EMISSIONS (TPY)
	0026	01	1	1	1	1	1	1
		02	0	0	0	0	0	0
	0028	01	0	0	0	0	0	0
	0029	01	10	0	11	0	13	0
		02	0	0	0	0	0	0
		03	0	0	0	0	0	0
		04	4	0	5	0	5	0
		05	142	1822	160	2054	180	2316
		06	61	0	69	0	78	0
		07	211	98	238	111	268	125
		08	1	0	1	0	1	0
		09	1	0	1	0	1	0
		10	2	0	2	0	3	0
		11	1	0	1	0	1	0
		12	1	0	1	0	1	0
		13	1	0	1	0	1	0
		14	19	0	22	0	25	0
		15	27	0	30	0	34	0
		16	32	0	36	0	40	0
		17	28	238	31	268	35	302
		18	12	0	14	0	16	0

TABLE 1-2. (Cont'd)

COUNTY NUMBER	PLANT NUMBER	PT. NO.	1975 PARTICULATE EMISSIONS (TPY)	1975 SO2 EMISSIONS (TPY)	1980 PARTICULATE EMISSIONS (TPY)	1980 SO2 EMISSIONS (TPY)	1985 PARTICULATE EMISSIONS (TPY)	1985 SO2 EMISSIONS (TPY)
	0029	19	0	0	0	0	0	0
		20	0	0	0	0	0	0
		21	0	0	0	0	0	0
		22	0	0	0	0	0	0
		23	1	0	1	0	1	0
		24	0	0	0	0	0	0
	0031	01	2	0	3	0	3	0
	0032	01	0	0	0	0	0	0
	0035	01	1	0	1	0	1	0
		02	1	0	1	0	1	0
		03	1	0	1	0	1	0
		04	1	0	1	0	1	0
	0046	01	0	0	0	0	0	0

TABLE 1-3. PROJECTED PARTICULATE AND SULFUR DIOXIDE EMISSIONS AT EXISTING PLANTS - DAVIESS COUNTY

COUNTY NUMBER	PLANT NUMBER	PT. NO.	1975 PARTICULATE EMISSIONS (TPY)	1975 SO2 EMISSIONS (TPY)	1980 PARTICULATE EMISSIONS (TPY)	1980 SO2 EMISSIONS (TPY)	1985 PARTICULATE EMISSIONS (TPY)	1985 SO2 EMISSIONS (TPY)
	1	1	0	0	0	0	0	0
		2	8	0	9	0	9	0
		3	18	0	19	0	20	0
		4	36	0	39	0	41	0
		5	13	0	14	0	15	0
		6	4	0	4	0	5	0
		7	4	0	4	0	5	0
		8	4	0	4	0	5	0
		9	4	0	4	0	5	0
	2	1	9	0	11	0	13	0
		2	28	0	34	0	40	0
		3	49	0	51	0	61	0
		4	87	0	90	0	108	0
		5	5	2	6	2	7	3
	4	1	2	0	2	0	2	0
		2	5	0	5	0	5	0
		3	11	0	21	0	31	0
		4	28	0	37	0	84	0
	6	1	0	0	0	0	0	0
		2	1	0	1	0	1	0

TABLE 1-3. (Cont'd)

COUNTY NUMBER	PLANT NUMBER	PT, NO,	1975 PARTICULATE EMISSIONS (TPY)	1975 S02 EMISSIONS (TPY)	1980 PARTICULATE EMISSIONS (TPY)	1980 S02 EMISSIONS (TPY)	1985 PARTICULATE EMISSIONS (TPY)	1985 S02 EMISSIONS (TPY)
	6	3	1	0	1	0	1	0
		4	1	0	1	0	1	0
		5	1	0	1	0	1	0
		6	0	0	0	0	0	0
		7	0	0	0	0	0	0
		8	0	0	0	0	0	0
		9	0	0	0	0	0	0
		10	0	0	0	0	0	0
		11	0	0	0	0	0	0
		12	0	0	0	0	0	0
		13	1	1	4	5	7	10
		14	0	0	0	0	0	0
	8	1	44	0	53	0	57	0
		2	76	0	92	0	99	0
		3	18	0	22	0	23	0
		4	1	0	1	0	1	0
	9	1	16	173	21	231	27	288
		2	16	173	21	231	27	288
		3	1	0	1	0	2	0
		4	2	0	3	0	3	0
		5	2	0	3	0	3	0

TABLE 1-3. (Cont'd)

COUNTY NUMBER	PLANT NUMBER	PT. NO.	1975 PARTICULATE EMISSIONS (TPY)	1975 SO2 EMISSIONS (TPY)	1980 PARTICULATE EMISSIONS (TPY)	1980 SO2 EMISSIONS (TPY)	1985 PARTICULATE EMISSIONS (TPY)	1985 SO2 EMISSIONS (TPY)
	9	6	2	0	3	0	3	0
		7	2	0	3	0	3	0
		8	2	0	3	0	3	0
		9	1	0	1	0	2	0
		10	0	0	0	0	0	0
	10	1	1	8	1	9	1	9
		2	0	0	0	0	0	0
		3	0	0	0	0	0	0
		4	0	0	0	0	0	0
	15	1	8	4	10	5	11	6
		2	162	0	181	0	200	0
	16	1	0	0	0	0	0	0
		2	0	0	0	0	0	0
		3	0	0	0	0	0	0
		4	0	0	0	0	0	0
		5	0	0	0	0	0	0
		6	0	0	0	0	0	0
		7	0	0	0	0	0	0
		8	0	1	0	1	0	1
		9	0	0	0	0	0	0
		10	0	0	0	0	0	0

TABLE 1-3. (Cont'd)

COUNTY NUMBER	PLANT NUMBER	PT. NO.	1975 PARTICULATE EMISSIONS (TPY)	1975 SO2 EMISSIONS (TPY)	1980 PARTICULATE EMISSIONS (TPY)	1980 SO2 EMISSIONS (TPY)	1985 PARTICULATE EMISSIONS (TPY)	1985 SO2 EMISSIONS (TPY)
	18	1	24	0	25	0	25	0
		2	43	0	44	0	45	0
		3	24	0	25	0	25	0
		4	4	0	4	0	4	0
	19	1	1	0	1	0	1	0
		2	3	0	4	0	4	0
	20	1	3	0	4	0	4	0
		2	17	0	20	0	24	0
	21	1	3	0	4	0	4	0
		2	10	0	12	0	15	0
	22	1	0	0	0	0	0	0
	23	1	1	0	1	0	1	0
		2	3	0	3	0	3	0
	24	1	1	0	1	0	1	0
		2	4	0	5	0	6	0
		3	0	0	0	0	0	0

TABLE 1-3. (Cont'd)

COUNTY NUMBER	PLANT NUMBER	PT. NO.	1975 PARTICULATE EMISSIONS (TPY)	1975 SO2 EMISSIONS (TPY)	1980 PARTICULATE EMISSIONS (TPY)	1980 SO2 EMISSIONS (TPY)	1985 PARTICULATE EMISSIONS (TPY)	1985 SO2 EMISSIONS (TPY)
	25	2	78	0	89	0	100	0
		3	6	0	7	0	9	0
		4	3	0	4	0	4	0
		5	12	0	15	0	18	0
	26	1	0	0	0	0	0	0
		2	0	0	0	0	0	0
		3	0	0	0	0	0	0
		4	31	1103	0	0	0	0
	27	1	137	24,633	160	28,830	187	33,725
		2	1232	32,487	1387	37,202	1564	42,668
	29	1	1	0	2	0	3	0
		2	3	0	6	0	11	0
		3	2	0	2	0	2	0
	30	1	6	0	7	0	8	0
		2	8	0	9	0	10	0

TABLE 1-3. (Cont'd)

COUNTY NUMBER	PLANT NUMBER	PT, NO,	1975 PARTICULATE EMISSIONS (TPY)	1975 SO2 EMISSIONS (TPY)	1980 PARTICULATE EMISSIONS (TPY)	1980 SO2 EMISSIONS (TPY)	1985 PARTICULATE EMISSIONS (TPY)	1985 SO2 EMISSIONS (TPY)
	31	1	48	0	57	0	69	0
	32	2	4	0	5	0	6	0
	33	1	0	0	0	0	0	0
		2	2	0	2	0	3	0
		3	2	0	2	0	3	0
		4	0	0	0	0	0	0
		5	1	0	1	0	1	0
		6	0	0	0	0	0	0
		7	4	0	5	0	5	0
		8	17	200	18	220	20	240
		9	14	165	15	182	16	198
		10	14	170	15	187	17	204
		11	14	170	15	187	17	204
		12	0	0	0	0	0	0
	34	1	0	0	0	0	0	0
		2	0	0	0	0	0	0
	35	1	26	1	41	2	65	3
		2	1	0	1	0	1	0
		3	1	0	1	0	1	0
		4	0	0	0	0	0	0
		5	1	0	1	0	1	0

TABLE 1-3. (Cont'd)

COUNTY NUMBER	PLANT NUMBER	PT. NO.	1975 PARTICULATE EMISSIONS (TPY)	1975 SO2 EMISSIONS (TPY)	1980 PARTICULATE EMISSIONS (TPY)	1980 SO2 EMISSIONS (TPY)	1985 PARTICULATE EMISSIONS (TPY)	1985 SO2 EMISSIONS (TPY)
	35	6	1	0	1	0	1	0
		7	0	0	0	0	0	0
		8	0	0	0	0	0	0
		9	0	0	0	0	0	0
		10	0	0	0	0	0	0
		11	0	0	0	0	0	0
	36	1	0	0	0	0	0	0
		2	0	0	0	0	0	0
		3	1	0	1	0	1	0
		4	0	2	0	2	0	3
	38	1	14	232	17	279	18	296
		2	14	232	17	279	18	296
	39	1	127	0	135	0	143	0
		2	127	0	135	0	143	0
		3	32	0	34	0	36	0
		4	32	0	34	0	36	0
		5	64	0	68	0	72	0
		6	0	0	0	0	0	0
		7	32	0	34	0	36	0
		8	32	0	34	0	36	0
		9	127	0	135	0	143	0
		10	5	0	5	0	6	0

TABLE 1-3. (Cont'd)

COUNTY NUMBER	PLANT NUMBER	PT. NO.	1975 PARTICULATE EMISSIONS (TPY)	1975 SO2 EMISSIONS (TPY)	1980 PARTICULATE EMISSIONS (TPY)	1980 SO2 EMISSIONS (TPY)	1985 PARTICULATE EMISSIONS (TPY)	1985 SO2 EMISSIONS (TPY)
	39	11	0	0	0	0	0	0
		12	3	0	3	0	3	0
		13	7	0	8	0	8	0
		14	13	0	14	0	15	0
		15	1	0	1	0	1	0
		16	5	0	5	0	6	0
		17	48	0	50	0	53	0
		18	5	0	5	0	6	0
		19	5	0	5	0	6	0
		20	54	0	57	0	60	0
		21	54	0	57	0	60	0
		22	49	0	51	0	55	0
		23	49	0	51	0	55	0
		24	74	0	78	0	83	0
		25	1	2	1	2	1	2
	40	1	1	0	1	0	1	0
		2	26	0	30	0	35	0
	41	1	0	0	0	0	0	0
		2	0	0	0	0	0	0
		4	0	0	0	0	0	0

TABLE 1-3. (Cont'd)

COUNTY NUMBER	PLANT NUMBER	PT. NO.	1975 PARTICULATE EMISSIONS (TPY)	1975 SO2 EMISSIONS (TPY)	1980 PARTICULATE EMISSIONS (TPY)	1980 SO2 EMISSIONS (TPY)	1985 PARTICULATE EMISSIONS (TPY)	1985 SO2 EMISSIONS (TPY)
	42	1	8	85	9	90	9	95
		2	1	48	1	50	1	53
		3	1	42	1	45	1	48
		4	1	42	1	45	1	48
		5	3	0	3	0	3	0
		6	3	0	3	0	3	0
		7	1	0	1	0	1	0
		8	0	0	0	0	0	0
	47	1	3	7	5	14	6	17
	55	1	25	0	25	0	25	0
	4	2	5	0	5	0	5	0
	36	3	1	0	1	0	1	0

1.1.2 New Sources

In addition to the data gathered for existing sources, the data reported for Vanderburgh and Henderson Counties was analyzed for information which indicated plans for the addition of new processes. Since no plant specific data is available for Daviess County, it was assumed for this analysis that there were no new processes. The purpose of this analysis was to estimate particulate and SO_2 emissions generated by new sources at existing facilities. The available data indicated that there would be one new process in Vanderburgh County and none in Henderson County. The projected emissions for this process are shown below:

County: Vanderburgh
Plant Number: 0005
Point Number: 04
SCC Number: 1-03-005-02
1975 Particulate Emissions: 1 ton
1975 SO_2 Emissions: 2 tons
1980 Particulate Emissions: 3 tons
1980 SO_2 Emissions: 8 tons
1985 Particulate Emissions: 3 tons
1985 SO_2 Emissions: 8 tons

1.1.3 Compliance Analysis

As will be discussed in detail in Section 1.3, each source which emitted particulates or SO_2 was subjected to a comparison with allowable emissions as determined by the applicable SIP and the federal New Source Performance Standards. The emissions reported in Tables 1-1, 1-2, and 1-3, represent emissions which were calculated assuming complete compliance with all state and federal regulations. There were, however, several sources which when analyzed solely on the basis of projected process parameters would generate emissions greater than those allowed by the regulations. These sources are listed in Table 1-4, 1-5, and 1-6 along with the projected emissions based on process parameters and the final projected emissions based on regulations for Vanderburgh, Henderson, and Daviess Counties.

TABLE 1-4. VANDERBURGH COUNTY COMPLIANCE ANALYSIS

			Violation		
Plant Number	Point Number	Regulation	Year	Actual Emissions (TPY)	Allowed Emissions (TPY)
5	1	5	75	29	14
		5	80	15	7
		5	85	6	3
	2	5	75	29	14
		5	80	14	7
		5	85	6	3
	3	5	75	29	14
		5	80	14	7
		5	85	6	3
9	2	4R	75	4	1
		4R	80	4	1
		4R	85	4	1
22	1	5	75	113	55
		5	80	198	97
		5	85	198	97
	2	5	75	120	59
		5	80	217	106
		5	85	217	106
	3	5	75	131	64
		5	80	242	119
		5	85	242	119
24	1	5	75	11	5
		5	80	14	6
		5	85	15	6
33	1	5	75	48	17
		5	80	45	16
		5	85	45	16

TABLE 1-5. HENDERSON COUNTY COMPLIANCE ANALYSIS

Plant Number	Point Number	Regulation	Violation Year	Actual Emissions (TPY)	Allowed Emissions (TPY)
0003	03	401 KAR 3:060 § 4	1975	28	14
		401 KAR 3:060 § 4	1980	28	14
		401 KAR 3:060 § 4	1985	28	14
0025	01	401 KAR 3:060 § 3	1975	4	3
		401 KAR 3:060 § 3	1980	5	3
		401 KAR 3:060 § 3	1985	5	3

TABLE 1-6. DAVIESS COUNTY COMPLIANCE ANALYSIS

				Violation	
Plant Number	Point Number	Regulation	Year	Actual Emissions (TPY)	Allowed Emissions (TPY)
2	3	401 KAR 3:060 Sec. 4	1975	67	49
		401 KAR 3:060 Sec. 4	1980	81	51
		401 KAR 3:060 Sec. 4	1985	97	61
	4	401 KAR 3:060 Sec. 4	1975	114	87
		401 KAR 3:060 Sec. 4	1980	137	90
		401 KAR 3:060 Sec. 4	1985	165	108
15	2	401 KAR 3:060 Sec. 4	1975	233	162
		401 KAR 3:060 Sec. 4	1980	274	181
		401 KAR 3:060 Sec. 4	1985	317	200
25	2	401 KAR 3:060 Sec. 4	1975	237	78
		401 KAR 3:060 Sec. 4	1980	284	89
		401 KAR 3:060 Sec. 4	1985	342	100
27	1	401 KAR 3:060 Sec. 3 Para. 4	1975	26581	24633
		401 KAR 3:060 Sec. 3 Para. 4	1980	31039	28830
		401 KAR 3:060 Sec. 3 Para. 4	1985	36310	33725
	2	401 KAR 3:060 Sec. 3 Para. 4	1975	44068	40931
		401 KAR 3:060 Sec. 3 Para. 4	1980	51460	47796
		401 KAR 3:060 Sec. 3 Para. 4	1985	60198	55912
	2	401 KAR 3:060 Sec. 3 Para. 3	1975	1292	1162
		401 KAR 3:060 Sec. 3 Para. 3	1980	1509	1308
		401 KAR 3:060 Sec. 3 Para. 3	1985	1765	1475

1.2 Data Acquisition

This aspect of the point source projection procedure involved acquiring both the 1974 baseline emissions and the growth parameters for the 1975, 1980, and 1985 projections. This section, therefore, is divided into a subsection on baseline data and a subsection on projection data. The data acquired by the methods described below were used as input to the projections procedures described in a subsequent section.

1.2.1 Baseline Data

The year which was used as a baseline in these procedures was 1974. The 1974 emission and process parameter data used was supplied by the Indiana Air Pollution Control Division (IAPCD) and the Kentucky Division of Air Pollution in the form of a 1974 National Emissions Data System (NEDS) point source inventory computer tape and a 1974 Emission Inventory Subsystem (EIS) printout.

When the baseline data was required for a projection, the data shown in Table 1-7 was drawn from the NEDS or EIS data base and was assumed to be correct.

TABLE 1-7. 1974 DATA AND NEDS LOCATION

Data	Location	
	Card	Column
County Number	All	3-6
Plant Number	All	10-13
Establishment Name	1	22-61
Point Number	2-6	14-15
SIC	2	18-21
Particulate Control Efficiency	3	53-55
SO_2 Control Efficiency	3	56-58
Operating Time	4	26-30
Particulate Emissions	4	31-37
SO_2 Emissions	4	38-44
Allowable Particulate Emissions	5	18-24
Allowable SO_2 Emissions	5	25-31
SCC	6	18-25
Operating Rate	6	26-32
Maximum Design Rate	6	33-39
Percent Sulfur	6	40-42
Percent Ash	6	43-45

1.2.2 Projections Data

The two types of data which were used for emission projections are (1) growth estimates provided by the emitting facility, and (2) growth estimates based on economic growth as projected by the United States Department of Commerce. The first type of data, as provided by the facility, was used whenever possible and the generalized growth factors were used only as a backup when more specific data was not available. The procedures used in obtaining the source specific estimates are discussed in the following section on the Growth Survey and the general factors are discussed in the section on OBERS Estimated Growth.

1.2.2.1 Growth Survey

The growth survey consisted of mailing a questionnaire to each facility listed in the 1974 NEDS point source inventory. This survey was completed for Vanderburgh County by the Evansville EPA and for Henderson and Daviess Counties by the Kentucky Division of Air Pollution. Copies of the actual growth surveys were used for Vanderburgh and Henderson Counties, while the growth survey results were tabulated by hand on to an EIS printout for Daviess County.

The values which were used as a basis for projections were the projected throughput or growth factor[1] and the projected emission control efficiency from the questionnaire. If a facility responded to the survey but did not supply this information, the overall projected plant growth was used along with the assumption that the emission control efficiency did not change from that reported for 1974. If neither of these methods was possible, due to no response or an incomplete response, generalized growth factors were used as described in the next section along with the assumption that the emission control efficiency did not change from that reported in 1974.

1.2.2.2 OBERS Estimated Growth

If no facility-supplied growth projections were available, a growth factor had to be developed from generalized economic forecasts for the geographic area containing the facility. The factors used for this purpose were developed from economic projections as reported in OBERS Series E.[2] These growth factors were derived by the following method:

1) Interpolate between 1971 and 1980 earnings as reported in OBERS to find earnings for 1974, 1975, 1980, and 1985 by the following equation:

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[1] The growth factor is defined as the throughput in the projection year divided by the throughput in the base year (1974).

[2] U.S. Dept. of Commerce, Social and Economic Statistics Admin., Regional Economic Analysis Div., 1972 OBERS Projections. Economic Activity in the U.S. 1929-2020, 7 Volumes. Washington, D.C., U.S. Water Resources Council, 1974.

$$\text{Earnings}_x = \text{Earnings}_{1971} \times \left[\frac{\text{Earnings}_{1980}}{\text{Earnings}_{1971}}\right]^{\left(\frac{x-1971}{9}\right)}$$

where x = the projection year (e.g., 1975)

2) Determine an earnings index for each year based on the following equation:

$$\text{Earning Index Year } x = \frac{\text{Earnings}_x}{\text{Earnings}_{1974}}$$

3) Find an OBERS multiple for 1974, 1975, 1980, and 1985 based on 1971 and 1980 multiples reported in OBERS by the following equation:

$$\text{Multiple}_x = \text{Multiple}_{1971} \times \left[\frac{\text{Multiple}_{1980}}{\text{Multiple}_{1971}}\right]^{\left(\frac{x-1971}{9}\right)}$$

4) Determine a multiples index for each year based on the following equation:

$$\text{Multiple Index}_x = \frac{\text{Multiple}_x}{\text{Multiple}_{1974}}$$

5) Determine a growth factor for each year by the following equation:

$$\text{Growth Factor}_x = \text{Earning Index}_x \times \text{Multiple Index}_x$$

These projections were followed for each year for each Standard Industrial Classification (SIC) for which OBERS data was available. The OBERS which was used in this analysis in Vanderburgh County were statewide OBERS projections developed for Indiana. The values for Henderson County were based on OBERS for the Evansville, Indiana-Kentucky SMSA and the values for Daviess County were from the Owensboro SMSA. A summary of the growth factors developed by this method are shown in Tables 1-8, 1-9, and 1-10 for Vanderburgh, Henderson, and Daviess Counties, respectively.

TABLE 1-8

GROWTH FACTORS DEVELOPED FROM OBERS SERIES E VANDERBURGH COUNTY

	SIC	1974/ 1974	1975/ 1974	1980/ 1974	1985/ 1974
Mining					
Metal	10	1.0000	--	--	--
Coal	11,12	1.0000	1.0147	1.0917	1.1377
Crude Petroleum, and Natural Gas	13	1.0000	0.9998	0.9987	1.0306
Non-Metallic, Except Fuels	14	1.0000	1.0341	1.2227	1.3166
Manufacturing					
Food and Kindred Products	20	1.0000	1.0206	1.1304	1.2408
Textile Mill Products	22	1.0000	--	--	--
Apparel and Other Fabric Products	23	1.0000	1.0347	1.2269	1.3628
Lumber Products and Furniture	24,25	1.0000	1.0367	1.2417	1.4138
Paper and Allied Products	26	1.0000	1.0445	1.2992	1.5018
Printing and Publishing	27	1.0000	1.0411	1.2734	1.5024
Chemicals and Allied Products	28	1.0000	1.0501	1.3404	1.6775
Petroleum Refining	29	1.0000	1.0336	1.2187	1.4085
Primary Metals	33	1.0000	1.0319	1.2070	1.3149
Fabricated Metals	34,19	1.0000	1.0527	1.3610	1.5843
Machinery, Excl. Electrical	35	1.0000	1.0387	1.2557	1.4216
Electrical Machinery	36	1.0000	1.0544	1.3750	1.7092
Motor Vehicles	371	1.0000	1.0392	1.2599	1.4730
Transportation, Equipment, exc. intr. v.	37 except 371	1.0000	1.0322	1.2091	1.3573
Other Manufacturing	21, 30-32, 38,39	1.0000	--	--	--
Transportation, Communication and Public Utilities	40-49	1.0000	--	--	--

NOTE: "--" indicates not available from OBERS

TABLE 1-9

GROWTH FACTORS DEVELOPED FROM OBERS SERIES E HENDERSON, COUNTY

	SIC	1974/ 1974	1975/ 1974	1980/ 1974	1985/ 1974
Agriculture, Forestry & Fisheries					
Mining		1	1.0119	1.0733	1.1384
Metal	10	1	1.0112	1.0693	1.1307
Coal	11,12	1	1.0117	1.0725	1.1370
Crude Petroleum & Natural Gas	13	1	.9973	.9842	.9712
Non-Metallic, except fuels	14	1	1.0145	1.0900	1.1711
Manufacturing		1			
Food, etc.	20	1	1.0101	1.0619	1.1163
Textile	22	1	1.0222	1.1410	1.2735
Apparel, Fabrics	23	1	1.0342	1.2235	1.4474
Lumber Products, Furniture	24,25	1	1.0203	1.1283	1.2477
Paper, Etc.	26	1	1.0375	1.2474	1.4997
Printing, Publishing	27	1	1.0366	1.2405	1.4845
Chemicals & Products	28	1	1.0326	1.2124	1.4234
Petroleum Refining	29	1	--	--	--
Primary Metals	23	1	1.0243	1.1548	1.3019
Fabricating Metals	19,34	1	1.0284	1.1830	1.3607
Machinery	35	1	1.0274	1.1759	1.3460
Electrical Machinery	36	1	1.0515	1.3514	1.7368
Motor Vehicles	371	1	1.0555	1.3831	1.8124
Transportation Equipment	37	1	1.0371	1.2446	1.4935
Other	21,30-32, 38,39	1	1.0425	1.2835	1.5800
Transportation, Communication, Public Utilities	40-49	1	---	---	---

TABLE 1-10

GROWTH FACTORS DEVELOPED FROM OBERS SERIES E
DAVIESS COUNTY

	SIC	1974/ 1974	1975/ 1974	1980/ 1974	1985/ 1974
Agriculture, Forestry and Fisheries					
Mining		1			
Metal	10	1	--	--	--
Coal	11,12	1	1.0041	1.0251	1.0464
Crude Petroleum and Natural Gas	13	1	.9947	.9685	.9430
Non-Metallic, Except Fuels	14	1	1.0236	1.1501	1.2922
Manufacturing		1			
Food, Etc.	20	1	1.0116	1.0718	1.1355
Textile	22	1	--	--	--
Apparel, Fabrics	23	1	1.0516	1.0518	1.1355
Lumber Products, Furniture	24,25	1	1.0233	1.1482	1.2884
Paper, Etc.	26	1	S	S	S
Printing, Publishing	27	1	1.0371	1.2446	1.4935
Chemicals & Products	28	1	1.0355	1.2326	1.4673
Petroleum Refining	29	1	--	--	--
Primary Metals	33	1	1.0244	1.1555	1.3035
Fabricating Metals	19,34	1	1.0343	1.2246	1.4498
Machinery	35	1	1.0394	1.2611	1.5301
Electrical Machinery	36	1	1.0383	1.2526	1.5112
Motor Vehicles	371	1	1.0353	1.2556	1.5115
Transportation Equipment	37	1	--	--	--
Other	21,30-32, 38,39	1	1.0375	1.2472	1.4993
Transportation, Communication, Public Utilities	40-49	1	--	--	--

1.3 Projection Methodology

The following discussion describes the methods used to calculate particulate and sulfur dioxide emissions for the projection years 1975, 1980, and 1985. The basis for these emission projections is as follows:

1) 1974 NEDS data as supplied by the IAPCD and KDAP.

2) EPA emission factors, AP-42.[1]

3) Process growth projections from the growth survey.

4) Emission control equipment projections from the growth survey.

5) Fuel characteristic projections, (i.e., % ash and % sulfur) from the growth survey.

6) Emission limitations due to the State SIP.

7) Emission limitations due to New Source Performance Standards (40 CFR 60).

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[1] Environmental Protection Agency, Compilation of Air Pollutant Emission Factors, 2nd Edition, AP-42 with Supplements, Research Triangle Park, NC, 1973.

8) Methods outlined in Guidelines for Air Quality Maintenance Planning and Analysis.[1,2]

9) Emissions calculation procedure as shown in A Guide to Compiling a Comprehensive Emissions Inventory, APTD 1135.[3]

The projections were made for each SCC process in the 1974 NEDS data base and each new source for which data was available. An overview of the method used to calculate these emissions is shown in the flow diagram in Figure 1-1. A more detailed discussion of the methods used is contained in the following numbered subsections. Each subsection number can be matched to the numbers contained in the steps shown in Figure 1-1. By using Figure 1-1 and these subsections, a complete methodology can be found for any process. These subsections, therefore, are presented in the order as shown in Figure 1-1 and not necessarily in order of importance, difficulty, or frequency of use.

The procedure outlined in Figure 1-1 and discussed in the subsequent subsections was carried out for every SCC process

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[1] Booz, Allen and Hamilton, Inc., Guidelines for Air Quality Maintenance Planning Analysis, Vol. 7, Projecting County Emissions, 2nd ed. EPA 450/4-74-008, Contract No. 68-02-1005, Task 4. Bethesda, Maryland, Jan. 1975.

[2] Baldwin, T. E. et al., Guidelines for Air Quality Maintenance Planning and Analysis, Volume 13, Allocating Projected Emissions to Subcounty Areas, Final Report, EPA 450/4-74-014. Argonne, Ill., Argonne Nat'l. Lab., Energy & Environmental Systems Div., Nov. 1974.

[3] Environmental Protection Agency (Office of Air and Water Programs), Guide for Compiling a Comprehensive Emission Inventory, revised. APTD-1135. Research Triangle Park, N.C., March 1973.

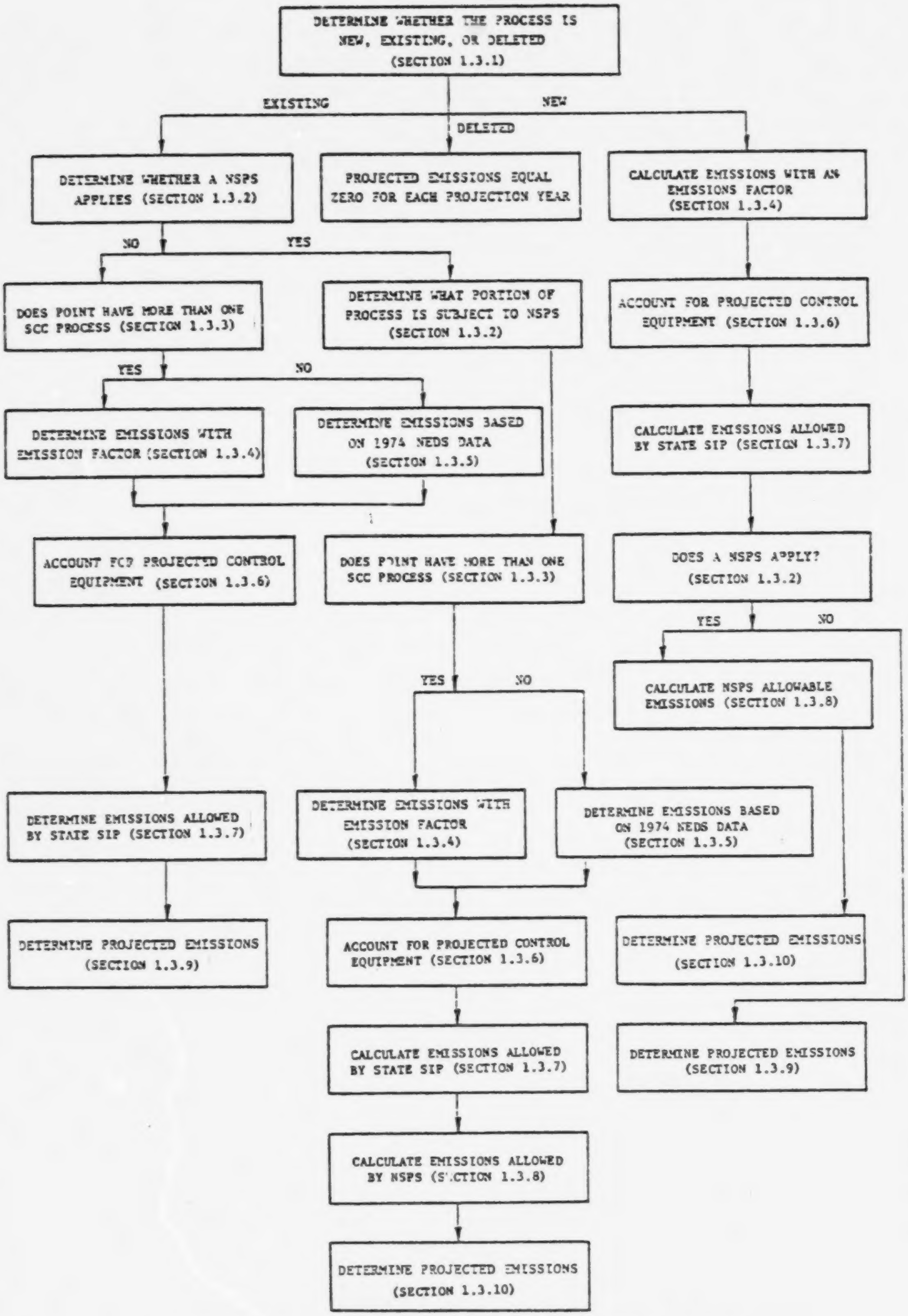
DETERMINE WHETHER THE PROCESS IS NEW, EXISTING, OR DELETED (SECTION 1.3.1)
EXISTING
DELETED
NEW
DETERMINE WHETHER A NSPS APPLIES (SECTION 1.3.2)
PROJECTED EMISSIONS EQUAL ZERO FOR EACH PROJECTION YEAR
CALCULATE EMISSIONS WITH AN EMISSIONS FACTOR (SECTION 1.3.4)
NO
YES
DOES POINT HAVE MORE THAN ONE SCC PROCESS (SECTION 1.3.3)
DETERMINE WHAT PORTION OF PROCESS IS SUBJECT TO NSPS (SECTION 1.3.2)
ACCOUNT FOR PROJECTED CONTROL EQUIPMENT (SECTION 1.3.6)
YES
NO
DETERMINE EMISSIONS WITH EMISSION FACTOR (SECTION 1.3.4)
DETERMINE EMISSIONS BASED ON 1974 NEDS DATA (SECTION 1.3.5)
CALCULATE EMISSIONS ALLOWED BY STATE SIP (SECTION 1.3.7)
ACCOUNT FOR PROJECTED CONTROL EQUIPMENT (SECTION 1.3.6)
DOES POINT HAVE MORE THAN ONE SCC PROCESS (SECTION 1.3.3)
DOES A NSPS APPLY? (SECTION 1.3.2)
YES
NO
CALCULATE NSPS ALLOWABLE EMISSIONS (SECTION 1.3.8)
YES
NO
DETERMINE EMISSIONS ALLOWED BY STATE SIP (SECTION 1.3.7)
DETERMINE EMISSIONS WITH EMISSION FACTOR (SECTION 1.3.4)
DETERMINE EMISSIONS BASED ON 1974 NEDS DATA (SECTION 1.3.5)
DETERMINE PROJECTED EMISSIONS (SECTION 1.3.9)
ACCOUNT FOR PROJECTED CONTROL EQUIPMENT (SECTION 1.3.6)
DETERMINE PROJECTED EMISSIONS (SECTION 1.3.10)
CALCULATE EMISSIONS ALLOWED BY STATE SIP (SECTION 1.3.7)
DETERMINE PROJECTED EMISSIONS (SECTION 1.3.9)
CALCULATE EMISSIONS ALLOWED BY NSPS (SECTION 1.3.8)
DETERMINE PROJECTED EMISSIONS (SECTION 1.3.10)

FIGURE 1-1. Emission Projection Methodology

in every projection year for each pollutant. That is, the procedures were followed once for each projection year (1975, 1980, and 1985) for each pollutant, thereby requiring six interations through Figure 1-1 for each SCC process. The bulk of the calculations for Vanderburgh were performed by computer. The calculations for Henderson and Daviess Counties were done manually.

1.3.1 Determination of Whether Source is New, Existing or Deleted

This determination was made on the basis of growth survey data and the 1974 NEDS data base. A new source was defined as any source for which data was supplied in the growth survey response but was not represented in the 1974 NEDS data base. A deleted source is any source which was in the 1974 NEDS but by the growth survey response was shown to no longer be in use after 1974. An existing source is any source in the 1974 NEDS which continued operation in any or all of the subsequent projection years.

1.3.2 Determination of Whether New Source Performance Standards (NSPS) Apply

The first type of case where this analysis was made was on a new source. The SCC number for the process was first compared to a listing of each SCC process for which there is currently or is projected to be an NSPS regulation. If the number was not on the list, NSPS did not apply. If the number was on the list, it was determined whether the process was operational before or after the NSPS became effective. If the process was operating before this date, NSPS are not applicable. If the process begin operation after the effective date, it was determined that NSPS did apply. For those sources which were found not to be subject to NSPS, it was assumed that they would have at least a 15-year operational life and would not be subject to the NSPS in any year of the projection period. The listing of SCC processes which was used to determine applicability was derived from the supplement to Volume 13 of the Guidelines (*Accounting for New Source Performance Standards in Projecting and Allocating Emissions - Hypothetical Example*).[1]

The second type of situation where an NSPS analysis was made was for existing sources. The method used for these processes is that outlined on pages 20 through 23 of Volume 7 of the Guidelines (see Appendix B) and the supplement to Volume 13.[1] The capacity which was used in this analysis was the capacity reported in the 1974 NEDS. Since the capacity was reported in NEDS as an hourly capacity, the annual capacity was determined by multiplying the hourly capacity by the operating time reported in NEDS (see Equation 1-1).

$$\text{Annual Capacity} = \text{Hourly Capacity} \times \frac{\text{weeks operated}}{\text{year}} \times \quad (1\text{-}1)$$

$$\frac{\text{days operated}}{\text{week}} \times \frac{\text{hours operated}}{\text{day}}$$

The equipment life was determined to be twice the upper limit equipment life as stipulated in *Tax Information on Depreciation*,

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[1] Environmental Protection Agency, Office of Air and Waste Management, *Accounting for New Source Performance Standards in Projecting and Allocating Emissions, Hypothetical Example*, EPA 450/4-74-014 b, A Supplement to Guidelines for Air Quality Maintenance Planning and Analysis, Vol. 13: Allocating Projected Emissions to Subcounty Areas.

Publication 534, Department of the Treasury, 1976. The replacement rate on this basis is calculated according to Equation 1-2.

$$\text{Replacement Rate} = \frac{1}{(\text{upper limit life} \times 2)} \qquad (1\text{-}2)$$

The "expected activity growth" (see Appendix B) was determined on the basis of growth survey or OBERS data. On the basis of this data, each process for which an NSPS might be applicable was subjected to the analysis as described in Appendix B. The calculation of allowable emissions from the data resulting from this analysis will be discussed in Section 1.3.8.

1.3.3 Determination of Whether NEDS Point Has More Than One SCC Process

This step is necessary since the NEDS emissions data cannot be used for projection of emissions at one SCC process if the reported NEDS emissions include more than one SCC process. If the point was comprised of more than one SCC process, projected emissions were calculated on the basis of EPA emission factors (see Section 1.3.4). If, however, the point was made up of only one SCC process, the methods shown in Section 1.3.5 were used. Determination of the number of SCC processes at a NEDS point was made by inspection of the NEDS printout.

1.3.4 Emissions Calculation by Use of Emission Factors

The emission factors which were used in these calculations were EPA factors as reported in EPA Publication AP-42.[1]

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[1] Environmental Protection Agency, Compilation of Air Pollutant Emission Factors, 2nd Edition, AP-42 with Supplements, Reserach Triangle Park, N.C., 1973.

The emissions which were calculated in this procedure are uncontrolled annual emissions. The equation used in this calculation is shown below as Equation 1-3 for general processes and Equation 1-4 for processes which included % ash or % sulfur in the emission factor.

$$\begin{array}{l}\text{Projected}\\ \text{Uncontrolled}\\ \text{Emissions (TPY)}\end{array} = \begin{array}{l}\text{Projected Annual}\\ \text{Throughput (SCC}\\ \text{units/year)}\end{array} \times \begin{array}{c}\text{Emission Factor}\\ \text{(lb/SCC unit)}\end{array} \times \frac{\text{ton}}{\text{2000 lb}} \tag{1-3}$$

$$\begin{array}{l}\text{Projected}\\ \text{Uncontrolled}\\ \text{Emissions (TPY)}\end{array} = \begin{array}{l}\text{Projected Annual}\\ \text{Throughput (SCC}\\ \text{units/year)}\end{array} \times \begin{array}{c}\text{Emission Factor}\\ \text{(lb/SCC unit)}\end{array} \tag{1-4}$$

$$\times \text{ \% ash or sulfur} \times \frac{\text{ton}}{\text{2000 lb}}$$

1.3.5 Emission Calculation by Use of NEDS Data

The emissions calculated by this method were based on growth survey data and 1974 NEDS data. The basic equations used were the same as those described in Section 1.3.4 (Equations 1-3 and 1-4) except that the emissions factor was found by use of the 1974 NEDS data as shown in Equation 1-5.

$$\text{Emission Factor lb/SCC Unit} = \frac{\text{1974 Emissions } {}^{\text{Ton}}/_{\text{Yr}}}{\text{1974 Throughput } \frac{\text{SCC Units}}{\text{Yr}}} \tag{1-5}$$

$$\times \frac{\text{2000 lb}}{\text{ton}}$$

Since the desired emissions rate to be calculated in this step was uncontrolled annual emissions, Equation 1-6 also had to be used.

$$\text{Uncontrolled Emissions (TPY)} = \text{Projected Emissions (Equations 1-3 \& 1-5)} \times \frac{100}{\text{100-1974 Control Efficiency (\%)}} \qquad (1\text{-}6)$$

The equation which was utlimately used in this analysis, therefore, is a combination of Equations 1-3, 1-5, and 1-6 and is shown in Equation 1-7.

$$\text{Projected Uncontrolled Emissions (TPY)} = \text{Projected Annual Throughput} \times \frac{\text{1974 Emissions}}{\text{1974 Throughput}} \times \frac{100}{\text{100-1974 Control Efficiency}} \qquad (1\text{-}7)$$

1.3.6 Accounting for Projected Control Efficiencies

This procedure was used to account for the reduction of predicted uncontrolled emissions due to the control equipment efficiency as projected by the sources and reported in the growth survey. If no control efficiency was projected, the equipment was assumed to be the same as that operating in 1974. The equation used in this calculation is shown in Equation 1-8 below.

$$\text{Projected Controlled Emissions} = \text{Projected Uncontrolled Emissions} \times \frac{\text{100 - Projected Control Eff.(\%)}}{100} \qquad (1\text{-}8)$$

1.3.7 Calculation of Emissions Allowed by State SIP

The quantity of particulate and SO_2 emissions allowed by the state SIP was determined in one of the following two ways:

1) If the throughput in the projection year was the same as the throughput in 1974, it was assumed that the allowable emissions as reported in NEDS were correct.

2) If the throughput was not the same as the 1974 throughput as reported in NEDS, the allowable emissions were recalculated using the applicable regulation.

When it was determined by the methods described in Section 1.3.2 that a portion of the process was subject to a NSPS the state allowables were calculated on the basis of that portion of the throughput which was regulated by state regulations. If the regulations required that a factor be determined which related allowed emissions to process input (e.g., Pt_f: pounds of particulate emissions per million Btu input in APC-4R) on the basis of a total capacity, the total plant capacity was used in all cases.

An example of such a calculation is shown below for a Daviess County point source:

Source Description: coal fired boiler (SCC Number 1-01-002-03)

Applicable Regulations:

1) Particulate - 401 KAR 3:060, Section 3

$$Y = 0.9634\ x^{-0.2356}$$

where

Y = pounds of particulate matter emitted per million Btu heat input.
x = million Btu heat input per hour.

For values of x less than 10, Y shall not exceed 0.56 and where x is greater than 10,000, Y shall not exceed 0.11.

2) Sulfur Dioxide - 401 KAR 3:060, Section 3

$$Y = 12.0284\ x^{-0.1260}$$

where

Y = maximum allowable sulfur dioxide emissions in pounds per million Btu fuel heat input.

x = heat input capacity in millions of Btu per hour.

The value of Y shall not exceed 9.0 lbs of sulfur dioxide nor shall it be required that Y be reduced below 6.0 lbs of sulfur dioxide per million Btu of heat input for solid fuels.

Calculation of Allowable Emissions:

1) Particulate -

The annual coal consumption for this boiler was dedermined to be 391,000 tons. The hourly input, therefore, is found as follows:

$$\frac{391{,}000\ \text{tons}}{8{,}736\ \text{hour}} \times 21 \times 10^6\ \text{Btu/ton} = 939.9 \times 10^6\ \text{Btu/hour}$$

Y is found from the equation of 401 KAR 3:060 as follows:

$$Y = 0.9634 \times 939.9^{-0.2356} = 0.1920\ \text{lb}/10^6\ \text{Btu}$$

The allowable particulate emissions for this point, therefore, is found as follows:

Allowable Particulate Emissions = 0.1920 lb/10^6 Btu x 391,000 tons/year x 21 x 10^6 Btu/ton x ton/2000 lb

= 788.3 tons per year

2) Sulfur Dioxide

The total heat input capacity of this boiler was reported in NEDS to be 72.450 tons of coal per hour. X, therefore, is found as follows:

X = 72.450 tons/hour x 21 x 10^6 Btu/ton
= 1521.5 x 10^6 Btu/hr

Y is then found from the equation of 401 KAR 3:060, Section 3 as follows:

$$Y = 12.0284 \times 1521.5^{-0.1260}$$

$$= 4.778 \text{ lb}/10^6 \text{ Btu}$$

The regulation, however, provides that Y is not required to be less than 6.0 lb/10^6 Btu. Y, therefore, is equal to 6.0 lb/10^6 Btu.

Allowable SO_2 Emissions = 6.0 lb/10^6 Btu x 391,000 tons/year x 21 x 10^6 Btu/ton x ton/2000 lb
= 24,633 tons/year

1.3.8 Calculation of Emissions Allowed by NSPS

The annual emissions allowed by the applicable NSPS were calculated on the basis of data presented in the supplement to Volume 13 of the Guidelines (Accounting for New Source Performance Standards in Projecting and Allocating Emissions). This data was in the form of a control efficiency which would be required to comply with the NSPS (an equivalent control efficiency). The allowed emissions, therefore, were calculated by applying this control efficiency to the uncontrolled emissions generated by the process or portion of the process found to be subject to the NSPS by the methods of Section 1.3.2. The equation used in this calculation is shown below as Equation 1-9.

$$\begin{array}{c}\text{NSPS}\\ \text{Allowed}\\ \text{Emissions}\end{array} = \begin{array}{c}\text{Projected}\\ \text{Uncontrolled}\\ \text{Emissions}\end{array} \times \frac{\text{\% of the process under NSPS}}{100} \qquad (1\text{-}9)$$

It should be noted that if the entire process was found to be subject to an NSPS (i.e., a new process beginning operation after the effective date of the NSPS), the second term on the right side of Equation 1-9 is unity.

1.3.9 Determination of Projected Emissions Where NSPS Do Not Apply

The projected emissions for a process where NSPS do not apply were determined to be the least of the actual controlled emissions based on process parameters (see Equation 1-8) and emissions allowed by the applicable state regulation, if any (see Section 1.3.7). Once the projected emissions had been determined for each SCC process at a point source, they were totaled to find the projected point source emissions. It should be noted that although this procedure assumes compliance with all applicable regulations, it does not consider compliance schedules, conditional variances or other enforcement measures which would permit emissions greater than that specified by the applicable regulation.

1.3.10 Determination of Projected Emissions Where an NSPS Applies

There are two possible cases where this determination must be made: (1) where the entire process is subject to an NSPS and (2) where a portion of the process is subject to an NSPS (See Section 1.3.2). The methods in these two cases are described below.

The Entire Process is Subject to an NSPS: The projected emissions in these cases were assumed to be the least of the actual projected controlled emissions (Equation 1-8), the NSPS allowed emissions (Equation 1-9), and the state allowed emissions (Section 1.3.7). (This assumes compliance with all applicable regulations.)

A Portion of the Process is Subject to an NSPS: In these cases, the SCC process was treated as if it were two processes - that is, one process subject to state regulations and and one process subject to an NSPS. The projected emissions for the state regulated portion of the process were determined to be the least of the projected controlled emissions determined by Equation 1-10 and the state allowed emissions determined in Section 1.3.7.

$$\begin{array}{c}\text{State Regulated}\\\text{Projected}\\\text{Emissions}\end{array} = \begin{array}{c}\text{Projected Controlled}\\\text{Emissions (from}\\\text{Equation 1-8)}\end{array} \times \frac{\begin{array}{c}\text{\% of Process}\\\text{under state}\\\text{regulation}\end{array}}{100} \qquad (1\text{-}10)$$

Once the emissions had been projected by the above methods for each portion of the process, the total projected emissions for the entire process were determined by totaling the projected emissions for each portion.

2.0 BASELINE AREA SOURCE EMISSIONS

This chapter describes the methods used to calculate 1974 particulate and sulfur dioxide area source emissions for Vanderburgh County, Indiana, Daviess County, Kentucky, and Henderson County, Kentucky. Each subsection contains a description of the methods used to calculate county total emissions and grid level emissions. The county total emissions are also included for each area source category. The most detailed methods were used wherever possible.[1],[2] The conversion of the emissions reported in this chapter to input format for the Climatological Dispersion Model is described in Chapter 4.0. The grid level emissions were submitted under a separate cover.

2.1 Introduction

The baseline emissions which are reported in this section have been divided into the following six general categories:

1) Fuels - Stationary Sources
2) Fuels - Highway Vehicles
3) Fuels - Off Highway
4) Solid Waste Disposal
5) Fugitive Dust Sources
6) Miscellaneous Area Sources

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[1] Booz, Allen and Hamilton, Inc., Guidelines for Air Quality Maintenance Planning and Analysis, Vol. 7, Projecting County Emissions, 2nd ed., EPA 450/4-74-008, Contract No. 68-02-1005, Task 4, Bethesda, Maryland, Jan. 1975.

[2] Baldwin, T. E. et al., Guidelines for Air Quality Maintenance Planning and Analysis, Volume 13, Allocating Projected Emissions to Subcounty Areas, Final Report, EPA 450/4-74-014, Argonne, Ill., Argonne Nat'l. Lab., Energy & Environmental Systems Div., Nov. 1974.

The methods and emissions within each of these general categories were developed and are reported separately for each of the three counties. The description of each specific source within these general categories has been divided into a subsection describing the county total emissions analysis and a subsection describing the methods used to apportion the county total emissions to subcounty grids. In some cases the emissions were determined on the grid level and aggregated to determine the county total.

The grids which were used in this portion of the area source analysis were subcounty areas which have previously been delineated in other studies (e.g., census tracts). This type of grid was used since, in many cases, data was available at the grid level. The methods used and grids chosen to convert emissions to the input format for the Climatological Dispersion Model (CDM) are discussed subsequently in Section 4.0. The pre-existing grids discussed in this section are referred to as "natural grids" and the modeling grids are referred to as "CDM grids". A description of the natural grids chosen for each county is as follows:

1) Vanderburgh County - The natural grids which were chosen for this county were census tracts as delineated within the 1970 Census.[1] These grids, along with the numbering system used within this report, are shown in Figures 2-1 and 2-2.

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[1] U.S. Bureau of the Census, Census of Population and Housing: 1970 CENSUS TRACTS, Final Report PHC (1)-65 Evansville, Ind.-KY. SMSA, Washington, D.C., GPO, 1972

NATURAL GRIDS
VANDERBURGH COUNTY, INDIANA

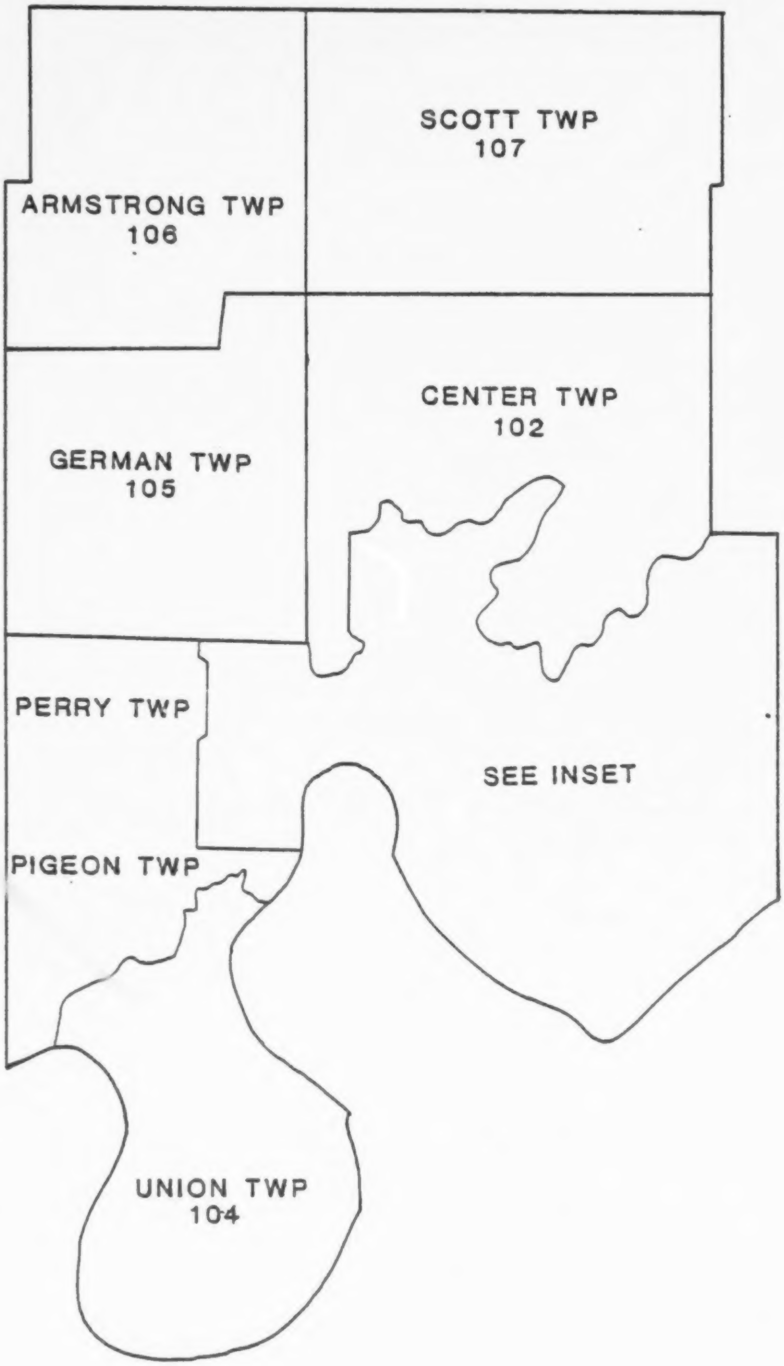
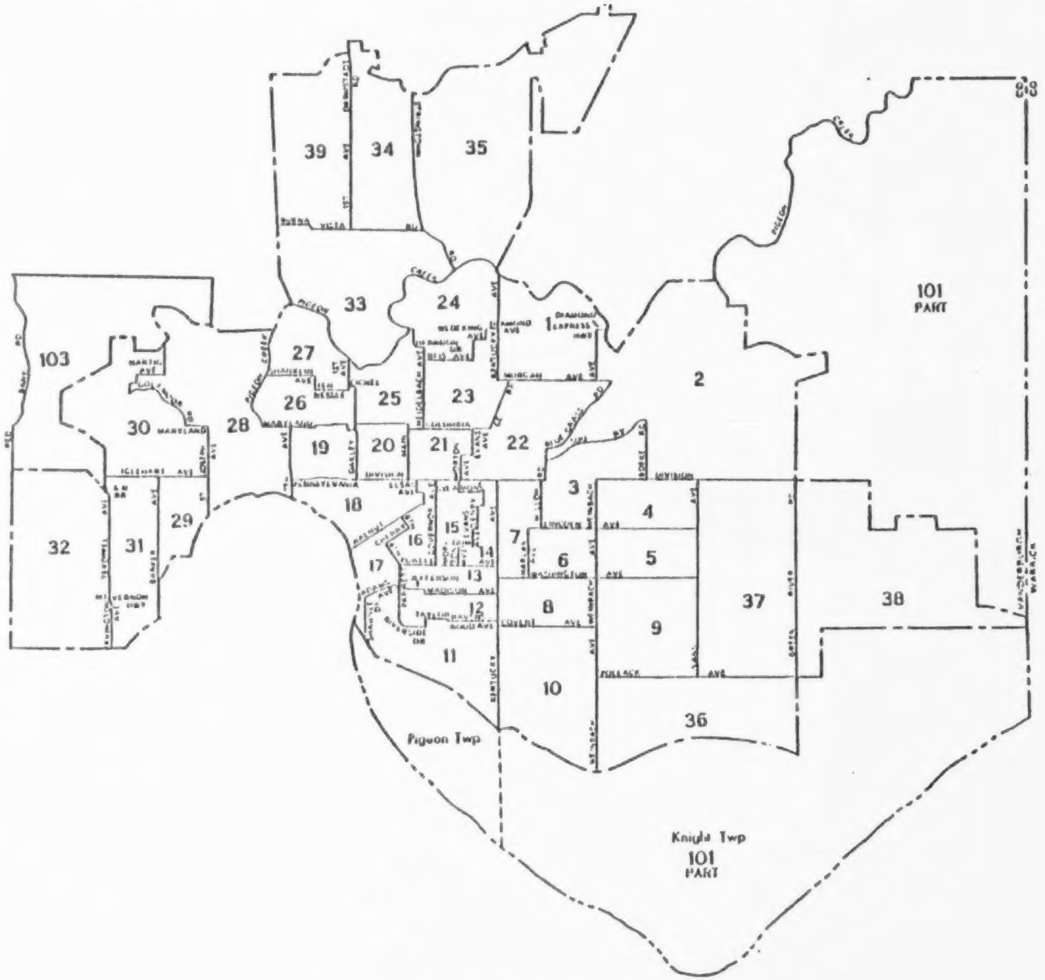

SCOTT TWP
107
ARMSTRONG TWP
106
CENTER TWP
102
GERMAN TWP
105
PERRY TWP
SEE INSET
PIGEON TWP
UNION TWP
104

FIGURE 2-1

NATURAL GRIDS
VANDERBURGH COUNTY, INDIANA
INSET - EVANSVILLE AND VICINITY



101 PART
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
103
Knight Twp
101 PART
Pigeon Twp
DIVISION
LINCOLN AVE
COVERT AVE
MARYLAND
PENNSYLVANIA
COLUMBIA
MORGAN AVE
DIAMOND AVE
BUENA VISTA RD
PIGEON CREEK
KENTUCKY
VANDERBURGH
WARRICK

FIGURE 2-2

2) Daviess County - Since there were no preexisting grids which covered all of Daviess County, square grids were developed, where local data was available, it was assigned to these grids on the basis of location. Since these grids were developed for use in this study, they were designed to be used both as natural grids and CDM grids. These grids, along with the numbering system chosen are shown in Figure 2-3 and Figure 2-4.

3) Henderson County - The natural grids which were chosen for this county are census tracts as developed in the 1970 Census.[1] Since three of the existing census tracts were irregularly shaped and relatively large, they were divided into a northern grid and a southern grid for use in this study. For example, census tract 206 was divided into grids 206N and 206S. These natural grids along with the numbering system chosen are shown in Figure 2-5 and Figure 2-6.

The methods used to apportion the county total emissions into these grids is discussed subsequently for each category of area sources. Since many of the methods used, however, relied on the same factors within the county, these repeatedly used factors are discussed below.

---

[1] U.S. Bureau of the Census, Census of Population and Housing: 1970 CENSUS TRACTS, Final Report PHC (1)-65 Evansville Ind.-KY. SMSA , Washington, D.C., GPO, 1972

NATURAL GRIDS
HENDERSON COUNTY, KENTUCKY

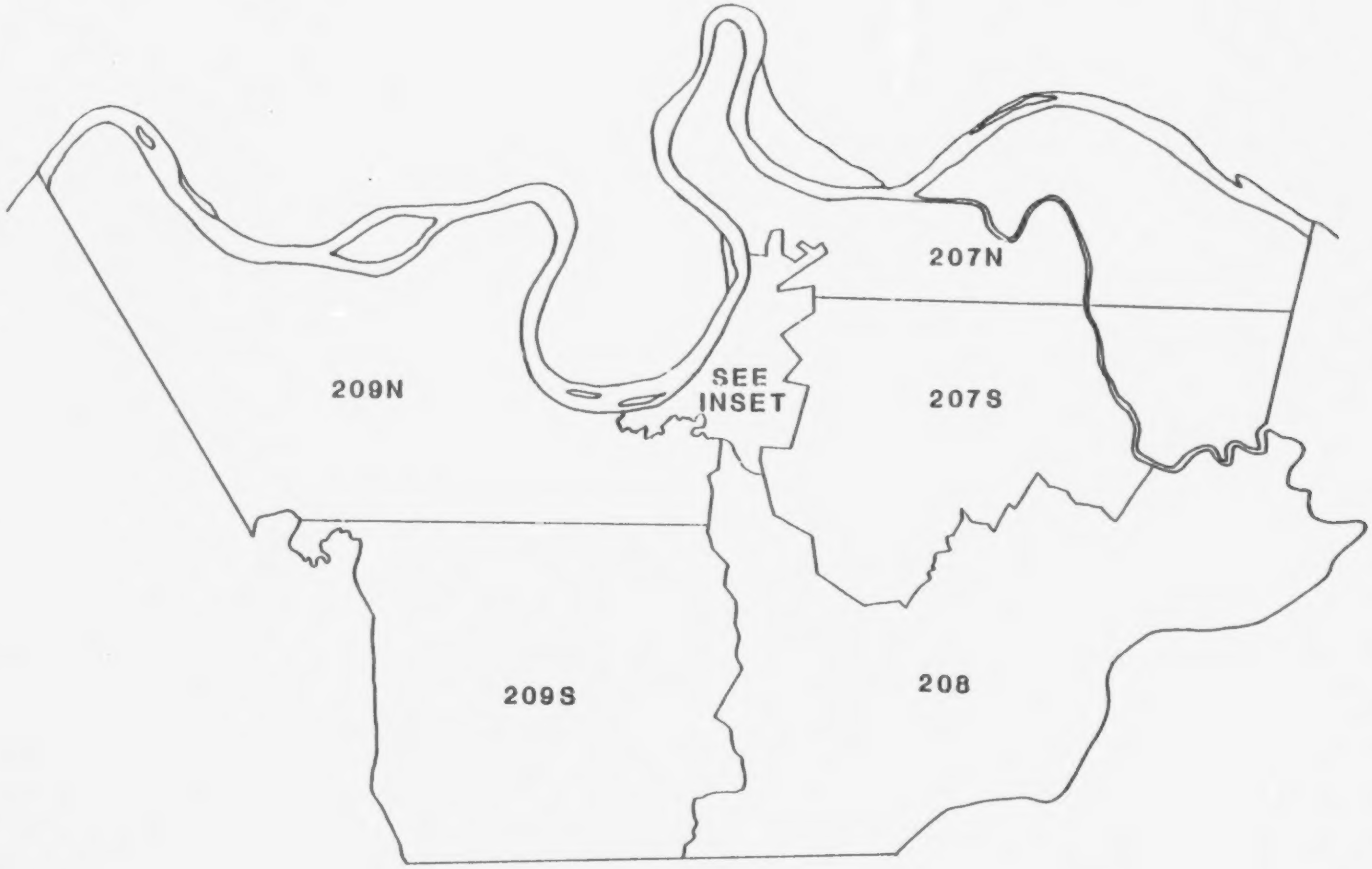

207N
207S
SEE
INSET
208
209N
209S

FIGURE 2-3

INSET - HENDERSON AREA NATURAL GRIDS
HENDERSON COUNTY, KENTUCKY

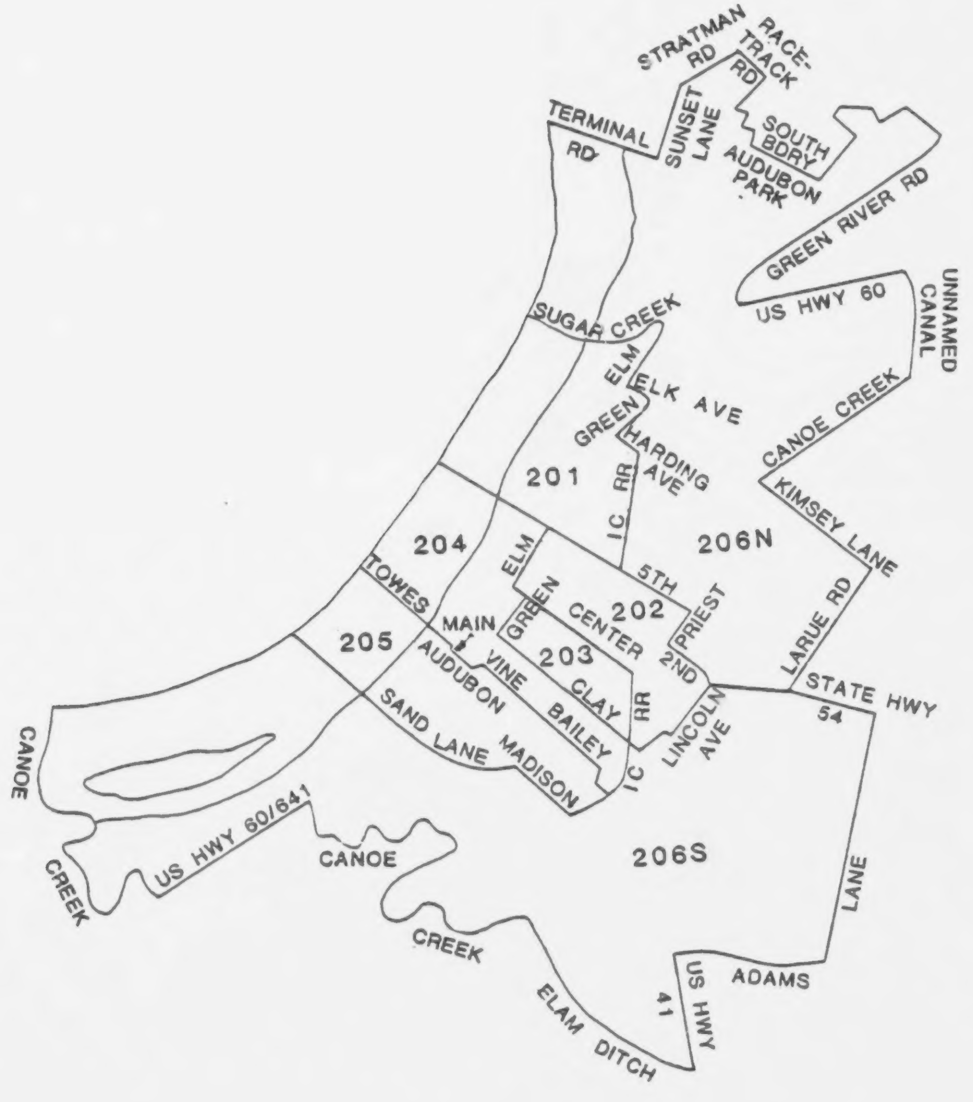
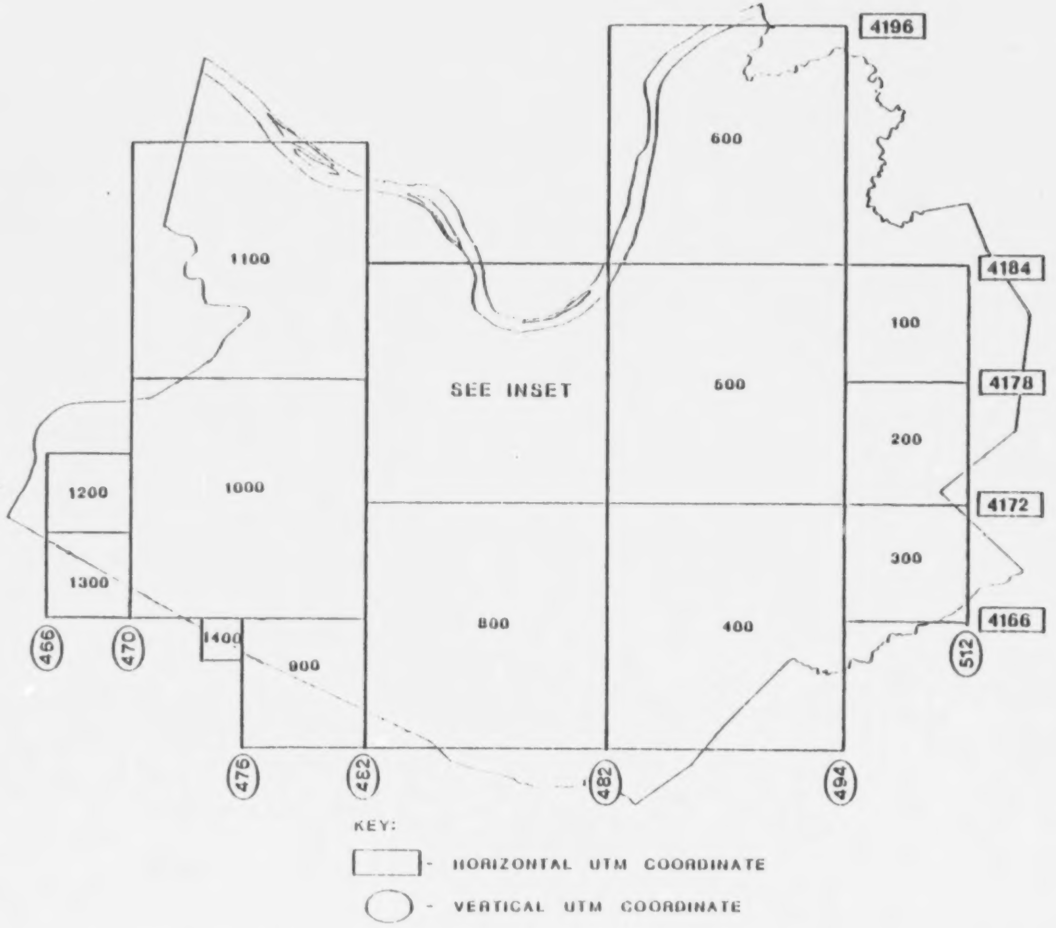

STRATMAN RD
RACE-TRACK RD
TERMINAL RD
SUNSET LANE
SOUTH BDRY
AUDUBON PARK
GREEN RIVER RD
US HWY 60
UNNAMED CANAL
SUGAR CREEK
ELM
ELK AVE
GREEN
HARDING AVE
CANOE CREEK
KIMSEY LANE
201
IC RR
206N
204
ELM
5TH
TOWES
GREEN
202
PRIEST
MAIN
CENTER
LARUE RD
205
203
2ND
AUDUBON
VINE
CLAY
STATE HWY 54
SAND LANE
BAILEY
RR
LINCOLN AVE
CANOE
MADISON
IC
US HWY 60/641
CANOE
206S
CREEK
LANE
CREEK
ADAMS
US HWY 41
ELAM DITCH

FIGURE 2-4

CDM GRIDS
DAVIESS COUNTY, KENTUCKY


4196
600
1100
4184
100
SEE INSET
500
4178
200
1200
1000
4172
300
1300
4166
800
400
1400
900
466
470
512
476
482
482
494
KEY:
- HORIZONTAL UTM COORDINATE
- VERTICAL UTM COORDINATE

02-1738-1

FIGURE 2-5

INSET - OWENSBORO AREA CDM GRIDS
DAVIESS COUNTY, KENTUCKY

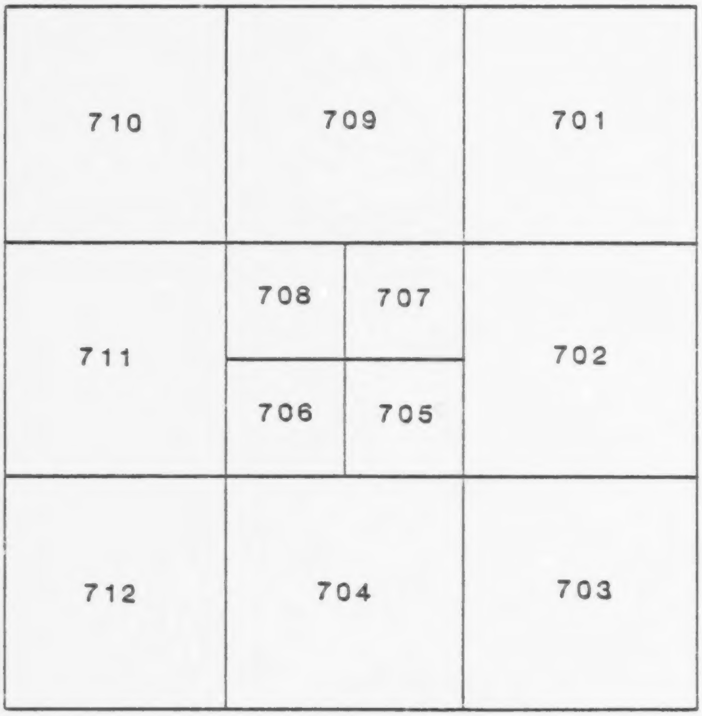

710
709
701
708
707
711
702
706
705
712
704
703

FIGURE 2-6

1) Vanderburgh County - The apportioning data used most often in this county was 1974 natural grid population. This data was developed from population statistics supplied by the Indiana Air Pollution Control Division (IAPCD) for the approximately 280 traffic zones. These zones were developed by the Evansville Urban Transportation Study. The population within the natural grids was found by aggregating the populations of the traffic zones within the grid. In the cases where a traffic zone was partially located in two or more natural grids, the population was apportioned into the grids on the basis of zone area within each grid. The natural grid population developed by this method is shown in Table A-1 of Appendix A.

   The second factor which was used for apportionment in several categories was employment. Employment data was developed from Bureau of Census data and data contained within the Evansville Urban Transportation Study. Table A-2 of Appendix A shows total employment, construction employment and manufacturing employment for 1970.

2) Daviess County - The apportioning factors which were repeatedly used in Daviess County were population and employment. The population for Daviess County was developed from information contained

in the Owensboro Urban Transportation Study and from 1972 OBERS Series E.[1] The method used is as follows:

a) Population within the Owensboro grids was determined from 1972 and 1995 data contained in the Owensboro Transportation Study. This data consisted of population data for 93 traffic study zones. The 1972 and 1995 data was aggregated into natural grids on the basis of zone location. Where a zone was partially in two or more grids, the population was apportioned into the grids on the basis of grid area. 1974 population was found by interpolation between the 1972 and 1995 data.

b) Population within the remainder of the county was found by subtracting the Owensboro population from the county total population as determined by interpolation between 1974 and 1980 OBERS data. This population was apportioned into the grids outside Owensboro on the basis of grid area.

A summary of the grid populations found by this method is shown in Table A-3 of Appendix A.

---

[1] U.S. Dept. of Commerce, Social and Economic Statistics Admin., Regional Economic Analysis Div., 1972 OBERS projections. Economic activity in the U.S. 1929-2020, 7 Vols. Statistics by economic area, water resources region and subarea, State, and SMSA and Non-SMSA portions of the areas, historical and projected. Washington, D.C., U.S. Water Resources Council, 1974. Population; Economics - projections

The Daviess County employment data which was used for apportioning was 1974 industrial employment. The data for the Owensboro area was supplied as part of the Owensboro Urban Area Transportation Study in the 93 zones discussed earlier. This data was for 1972 and 1995. 1974 data was found by interpolation. This employment was aggregated into the natural grids by the same method discussed earlier for population. The employment for the remainder of the county was found by subtracting the Owensboro employment from county total 1974 employment as reported in County Business Patterns.[1] This employment was apportioned into the grids outside Owensboro on the basis of grid area. Table A-4 of Appendix A show the 1974 grid industrial employment as determined by this method.

3) Henderson County - The Henderson County data which was used in several of the apportioning procedures was population. The population within the Henderson (city) urban area was supplied for 82 zones in the Henderson Transportation Study. This data was aggregated into the natural grids on the basis of location by the same methods discussed previously for the other counties. This aggregated data was used to scale up census tract data as reported by the Bureau of the Census.[2] The equation used in this procedure is as follows:

$$\text{1974 Pop.} = \text{1970 Census Tract Pop.} \times \frac{\text{1974 OBERS Population}}{\text{1970 OBERS Population}}$$

---

[1] U.S. Department of Commerce, Bureau of the Census, County business patterns 1974, Kentucky. CBP-74-19. Washington, D.C., GPO, Nov. 1976.

[2] U.S. Bureau of the Census, Census of Population and Housing: 1970 CENSUS TRACTS, Final Report PHC (1)-65 Evansville Ind. -KY. SMSA, Washington, D.C., GPO, 1972

The population for the grids outside Henderson (city) was determined by scaling up census tract data with population projections determined from an interpolation of 1970 and 1980 OBERS data for the SMSA containing Henderson County. The equation used in this procedure is as follows:

$$\text{1974 Population} = \text{1970 Census Tract Pop.} \times \frac{\text{1974 OBERS Population}}{\text{1970 OBERS Population}}$$

A summary of the natural grid population as determined by these methods is shown in Table A-5 of Appendix A.

The apportioning factors discussed above are mentioned periodically within the subsequent text with regard to sub-county apportionment. The equation used within this apportionment is as follows:

$$\begin{matrix}\text{Grid}\\ \text{Emissions}\end{matrix} = \begin{matrix}\text{Area total}\\ \text{Emissions}\end{matrix} \times \frac{\text{Grid population or employment}}{\text{Area total population or employment}}$$

The gridded emissions determined by this method and other methods discussed for each area source are generally not included in the text of this section. The entire gridded inventory was submitted to the regional office under a separate cover.

2.2 Fuels - Stationary Sources

This section includes emissions from the combustion of fossil fuels in boilers and furnaces in residences and commercial/institutional (C/I) and industrial establishments. The area source commercial/institutional and industrial establishments considered here exclude the point source facilities analyzed in Chapter 1.0.

2.2.1 Vanderburgh County

The determination of the quantities of fuels sold to stationary sources in Vanderburgh County was attempted by the Evansville EPA. This determineation was to be made by a survey of all fuel dealers in the area. The results of this survey, however, was inadequate in that the survey response was very incomplete. A comparison was made of the heating value (in Btu's) of the reported fuel sales from the survey with the heating value of the 1972 county totals reported for Vanderburgh County through the EPA's National Air Data Branch (NADB) by the regional office. The comparison showed that less than fifteen percent of the NADB heating values for 1972 were reported within the survey. The major reason for the discrepancy is probably due to lack of information from the counties' natural gas supplier. For this reason, it was determined that the fuel survey results should be supplemented. The emissions reported below were calculated from county total fuel use as reported by NADB for 1972 for all fuels except for Liquified Petroleum Gas (LPG). The survey results were used for LPG.

2.2.1.1 Residential Fuels

County Totals

The quantities of fuel used for residential purposes in Vanderburg County as reported by NADB are shown below in Table 2-1. The emissions generated by this fuel consumption were calculated based on EPA emission factors and are shown in Table 2-1.

Subcounty Apportionment

The county total fuel usage was apportioned to the grids based on the count of occupied dwelling units by heating fuel, as presented in the fourth count of the 1970 census on the township level. For Knight and Pigeon Townships, the total fuel usage was apportioned to census tracts on the basis of 1974 population. Since the population of Vanderburgh County only increased by about 5%, it was felt that there was no significant shift in the type of fuel used in dwelling units due to new housing during this time. The method used, therefore, can be summarized by the following general steps illustrated for natural gas:

1) $$\frac{\text{1974 grid population}}{\text{1970 grid population}} \times \begin{array}{l}\text{1970 dwelling units}\\ \text{using natural gas}\\ \text{in the grid}\end{array} =$$

   1974 dwelling units using natural gas in the grid

2) Total from all grids of 1974 dwelling units using natural gas = county total dwelling units using natural gas

TABLE 2-1. EMISSIONS FROM RESIDENTIAL FUEL USE - VANDERBURGH COUNTY

Fuel	Quantity Burned	Emission Factor		% S[1]	Emissions (tons/year)	
		Particulate	SO_2		Particulate	SO_2
Natural Gas	$9290 \times 10^6 ft^3$	$10^{lb}/10^6 ft^3$	$0.6^{lb}/10^6 ft^3$		45.6	2.8
Liquid Petroleum Gas	$2285 \times 10^3 gal$	$1.85^{lb}/10^3 gal$	$0.014^{lb}/10^3 gal$		2.1	neg
Distillate Oil	$1960 \times 10^3 gal$	$2.5^{lb}/10^3 gal$	$144S^{lb}/10^3 gal$	0.3	2.5	42.3
Residual Oil	0	$16.5^{lb}/10^3 gal$	$159S^{lb}/10^3 gal$	1.7	0	0
Anthracite Coal	440 tons	$10.0^{lb}/ton$	$36.8S^{lb}/ton$	0.6	2.2	4.9
Bituminous Coal	7040 tons	$20^{lb}/ton$	38S	3.3	70.4	441.4
Wood	0				0	0
TOTAL					122.8	491.4

[1] % S = Sulfur Percentage

3) $$\frac{\text{1974 dwelling units using natural gas in the grid}}{\text{county total dwelling units using natural gas}} = \text{natural gas grid apportioning factor}$$

4) $$\text{grid apportioning factor} \times \text{county total emissions} = \text{grid emissions}$$

This procedure was used for each fuel within each grid to determine emissions from residential fuel use. Table 2-2 shows, by fuel type, the distribution of dwelling units in Vanderburgh County assumed for 1974.

TABLE 2-2. DWELLING UNITS BY FUEL TYPE

Fuel	Dwelling Units	
Natural Gas	51,093	88.3%
LPG	1,790	3.1%
Fuel Oil (#2 Distillate)	2,662	4.6%
Coal	1,335	2.3%
Wood	0	---
Electricity	929	1.6%
Other	40	---
None	0	---
TOTAL	57,849	100%

SOURCE: Census of Housing

2.2.1.2 Commercial/Institutional Fuels

County Totals

The county total fuel use as reported by NADB for these categories are shown below in Table 2-3. The emissions generated by this fuel use were calculated on the basis of EPA emission factors and are also shown in Table 2-3.

Subcounty Apportionment

The county total particulate and SO_2 emissions were apportioned into the grids on the basis of 1974 population. The equation used in the apportioning procedure is as follows:

$$\text{County total emissions} \times \frac{\text{1974 grid population}}{\text{1974 county population}} = \text{1974 grid emissions}$$

2.2.1.3 Industrial Fuel

County Totals

The county total area source industrial fuel use as reported by NADB is shown in Table 2-4. The emissions were calculated on the basis of these fuel uses and EPA emission factors and are also shown in Table 2-4. Discussions with the Evansville EPA led to the conclusion that the amount of coal consumption reported in the NADB is probably high. The NADB estimate has been used to be conservative.

TABLE 2-3. VANDERBURGH COUNTY COMMERCIAL/INSTITUTIONAL AREA SOURCES EMISSIONS

Fuel	Quantity Burned	Emission Factor		County Total Emissions (tons/yr)	
		Particulate	SO_2	Particulate	SO_2
Natural Gas	$1{,}560 \times 10^6 ft^3$	$10\ lb/10^6 ft^3$	$0.6\ lb/10^6 ft^3$	7.8	0.5
LPG	$899 \times 10^3 gal$	$1.85\ lb/10^3 gal$	$0.014\ lb/10^3 gal$	0.8	neg
Distillate Oil	$8{,}800 \times 10^3 gal$	$2\ lb/10^3 gal$	$43.2\ lb/10^3 gal$	8.8	190.1
Residual Oil	$250 \times 10^3 gal$	$16.5\ lb/10^3 gal$	$214.7\ lb/10^3 gal$	2.1	26.8
Anthracite Coal	0			0	0
Bituminous Coal	1,404 ton	52.2 lb/ton	117.8 lb/ton	36.6	82.7
TOTAL				56.1	300.1

TABLE 2-4. VANDERBURGH COUNTY INDUSTRIAL FUEL USE AREA SOURCE EMISSIONS

Fuel	Quantity Burned	Emission Factor		Emissions (tons/year)	
		Particulate	SO_2	Particulate	SO_2
Natural Gas	$4,730 \times 10^6 ft^3$	$10\ lb/10^6 ft^3$	$0.6\ lb/10^6 ft^3$	23.7	1.4
LPG	$331 \times 10^3 gal$	$1.85 \times 10^3 gal$	$0.014\ lb/10^3 gal$	0.3	neg
Distillate Oil[1]	$233 \times 10^3 gal$	$15\ lb/10^3 gal$	$144S\ lb/10^3 gal$	1.7	5.0
Residual Oil[2]	$580 \times 10^3 gal$	$23\ lb/10^3 gal$	$159S\ lb/10^3 gal$	6.7	78.4
Anthracite Coal	0	–	–	0	0
Bituminous Coal[3]	45,230 ton	$13\ A\ lb/10^3 gal$	$38S\ lb/10^3 gal$	2,645.0	2,835.9
TOTAL				2,677.4	2,920.7

1: Based on 0.3% Sulfur

2: Based on 1.7% Sulfur

3: Based on 3.3% Sulfur and 9.0% Ash

Subcounty Apportionment

The county total particulate and SO_2 emissions generated by industrial area source fuel use were apportioned into the grids on the basis of manufacturing employment as reported by the Bureau of Census for 1970. The basic equation used is as follows:

$$\text{County total emissions} \times \frac{\text{grid manufacturing employment}}{\text{county manufacturing employment}} = \text{grid emissions}$$

2.2.2 Daviess County

In order to determine the quantities of fuel sold to users in Daviess County, a survey of all identifiable dealers was conducted. Since the number of dealers which responded with useable data was somewhat limited (about 60% response) and the recontacts are completed, data was also obtained from the National Air Data Branch (NADB) of the USEPA for use where the survey results were determined to be inadequate.

The values used for the emissions analysis were determined by a comparison of the fuel survey results and the NADB data. Since the fuel survey response was incomplete, it was assumed that whenever the survey fuel use data was substantially smaller than the NADB value the survey was inadequate and the backup NADB values should be used.

2.2.2.1 Residential Fuel

County Totals

The quantities of fuel used for residential purposes in Daviess County as determined by the fuel survey and as supplied by NADB are shown in Table 2-5. The fuel use values which were used in the emissions analysis along with the emissions calculated with EPA emission factors are shown in Table 2-6.

TABLE 2-5. RESIDENTIAL FUEL USE DATA - DAVIESS COUNTY

Fuel Type	Fuel Survey Data	NADB Data
Natural Gas (10^6 Ft^3)	2,744	2,650
LPG (10^3 gal)	985	no data
Distillate Oil (10^3 gal)	138	580
Residual Oil (10^3 gal)	0	0
Anthracite Coal (tons)	0	0
Bituminous (tons)	126,806	2,080

Subcounty Apportionment

The county total particulate and sulfur dioxide emissions in Daviess County were apportioned into the natural grids on the basis of population by the following equation:

$$\text{1974 grid emissions} = \frac{\text{1974 grid population}}{\text{1974 county population}} \times \text{1974 county total emissions}$$

TABLE 2-6. EMISSIONS FROM RESIDENTIAL FUEL USE - DAVIESS COUNTY

Fuel	Quantity Burned	Emission Factor		% S[3]	Emissions (tons/year)	
		Particulate	SO_2		Particulate	SO_2
Natural Gas[2]	$2744 \times 10^6 \text{ft}^3$	$10^{\text{lb}}/10^6\text{ft}^3$	$0.6^{\text{lb}}/10^6\text{ft}^3$		13.7	0.8
Liquid Petroleum Gas[2]	$985 \times 10^3 \text{gal}$	$1.85^{\text{lb}}/10^3\text{gal}$	$0.014^{\text{lb}}/10^3\text{gal}$		0.9	neg
Distillate Oil[1]	$580 \times 10^3 \text{gal}$	$2.5^{\text{lb}}/10^3\text{gal}$	$144S^{\text{lb}}/10^3\text{gal}$	0.3	0.7	12.5
Residual Oil	0	$16.5^{\text{lb}}/10^3\text{gal}$	$159S^{\text{lb}}/10^3\text{gal}$	1.7	0	0
Anthracite Coal	0	$10.0^{\text{lb}}/\text{ton}$	$36.8S^{\text{lb}}/\text{ton}$	0.6	0	0
Bituminous Coal[2]	126,806 tons	$20^{\text{lb}}/\text{ton}$	38S	3.3	1268.1	7950.7
Wood	0				0	0
TOTAL					1283.4	7964.0

[1] NADB value used

[2] Fuel survey data used

[3] % S = sulfur content of fuel (percent)

2.2.2.2 Commercial/Institutional Fuel

County Totals

The quantities of fuel used by commercial and institutional area sources as determined by the fuel survey and as supplied by the NADB are shown in Table 2-7. The fuel use values which were used in the emissions analysis along with the particulate and SO_2 emissions calculated using EPA emission factors are shown in Table 2-8. Review of the point source facilities showed no commercial/institutional sources. Therefore, all fuel survey sales in this category were assumed to be consumed by area sources.

TABLE 2-7. COMMERCIAL/INSTITUTIONAL FUEL USE DATA - DAVIESS COUNTY

Fuel Type	Fuel Survey Data	NADB Data
Natural Gas (10^6 Ft^3)	1,155	1,350
LPG (10^3 gal)	185	no data
Distillate Oil (10^3 gal)	647	0
Residual Oil (10^3 gal)	0	510
Anthracite Coal (tons)	0	0
Bituminous (tons)	48,662	0

Subcounty Apportionment

The county total emissions generated by these sources were apportioned into the natural grids on the basis of 1974 grid population.

TABLE 2-8. COMMERCIAL/INSTITUTIONAL AREA SOURCES EMISSIONS

Fuel	Quantity Burned	Emission Factor		Emissions (tons/year)	
		Particulate	SO_2	Particulate	SO_2
Natural Gas[1]	$1350 \times 10^6 ft^3$	$10\ lb/10^6 ft^3$	$0.6\ lb/10^6 ft^3$	6.8	0.4
LPG[2]	$185 \times 10^3 gal$	$1.85\ lb/10^3 gal$	$0.014\ lb/10^3 gal$	0.2	neg
Distillate Oil[2,3]	$647 \times 10^3 gal$	$15\ lb/10^3 gal$	$14.4\ lb/10^3 gal$	4.8	4.7
Residual Oil[1,4]	$510 \times 10^3 gal$	$23\ lb/10^3 gal$	$270.3\ lb/10^3 gal$	5.8	68.9
Anthracite Coal	0	-	-	0	0
Bituminous Coal[2,5]	48,662 tons	53.9 lb/ton	38(s) lb/ton	1311.4	3051.0
TOTAL				1329.0	3125.0

[1] NADB data used

[2] Fuel survey data used

[3] Emission factor based on 0.1% sulfur

[4] Emission factor based on 1.7% sulfur

[5] Emission factor based on 9.3% ash and 3.3% sulfur

2.2.2.3 Industrial Fuel

County Totals

The county total industrial fuel use as determined by the fuel dealer survey and as supplied by the NADB are shown in Table 2-9. The methods used in the determination of which of these values to use in the analysis differed from the methods used for residential and commercial/institutional sources in that in this category it was possible that the sales value reported by the dealers within the survey included sales to point sources. In this category, therefore, if the fuel use reported by the survey greatly exceeded the NADB value, the NADB value was used. The fuel use values which were determined by this method and the resulting emissions are reported in Table 2-10.

TABLE 2-9. INDUSTRIAL FUEL USE DATA - DAVIESS COUNTY

Fuel Type	Fuel Survey Data	NADB Data
Natural Gas (10^6 Ft^3)	3,327	880
LPG (10^3 gal)	935	no data
Distillate Oil (10^3 gal)	462	900
Residual Oil (10^3 gal)	0	1,850
Anthracite Coal (tons)	0	0
Bituminous (tons)	925,307	0

Subcounty Apportionment

The county total industrial fuel use emissions were apportioned into the natural grids on the basis of 1974 grid industrial employment by the following equation:

TABLE 2-10. INDUSTRIAL FUEL USE AREA SOURCE EMISSIONS
DAVIESS COUNTY

Fuel	Quantity Burned	Emission Factor		Emissions (tons/year)	
		Particulate	SO_2	Particulate	SO_2
Natural Gas [1]	880x10^{6}ft^3	10 lb/10^{6}ft^3	0.6 lb/10^{6}ft^3	4.4	0.3
LPG [2]	935x10^{3}gal	1.85x10^{3}gal	0.014 lb/10^{3}gal	0.9	neg
Distillate Oil [1,3]	900x10^{3}gal	15 lb/10^{3}gal	144S lb/10^{3}gal	6.8	6.5
Residual Oil [1,4]	1850x10^{3}gal	23 lb/10^{3}gal	159S lb/10^{3}gal	21.3	250.0
Anthracite Coal	0	-	-	0	0
Bituminous Coal [1]	0	-	-	0	0
TOTAL				33.4	256.8

[1] NADB data used

[2] Fuel survey data used

[3] Based on 0.1% sulfur

[4] Based on 1.7% sulfur

$$\text{County total emissions} \times \frac{\text{1974 grid industrial employment}}{\text{1974 county industrial employment}} = \text{1974 grid emissions}$$

2.2.3 Henderson County

A fuel dealers survey was also attempted in Henderson County. The survey was performed in conjunction with the Vanderburgh County survey by the Evansville EPA. The percent of the dealers which responded to the survey by fuel type is shown below in Table 2-11. Due to the somewhat incomplete response, the fuel sales data were compared to other values. The back-up data used were the previously reported fuel usages reported by the National Air Data Branch (NADB) of the USEPA for 1972. The quantities of fuel sales as determined by the survey are shown below in Table 2-12.

The values used for the emissions analysis were determined by a comparison of the fuel dealer survey results and the NADB data. Since the fuel dealer survey was incomplete, it was assumed that whenever the survey fuel use data was substantially smaller than the NADB value, the survey was inadequate and the back-up NADB values should be used.

TABLE 2-11. PERCENT FUEL SURVEY RESPONSE - HENDERSON COUNTY

Fuel Type	Percent of Dealers Responding
Natural Gas	0 (no data available)
LPG	67%
Fuel Oil	67%
Coal	25%

TABLE 2-12. FUEL DEALER SURVEY RESULTS - FUEL SALES BY CATEGORY - HENDERSON COUNTY

	Quantity Sold by Category		
Fuel Type	Residential	Commercial/ Institutional	Industrial
Natural Gas	-	NO DATA AVAILABLE	-
LPG (10^3 gal)	2,200	125	125
Fuel Oil*(10^3 gal)	509	440	404
Coal (tons)	0	35,100	0

*Assume distillate No. 2

2.2.3.1 Residential Fuel

County Totals

The quantities of fuel used for residential purposes in Henderson County as determined by the method described above are shown in Table 2-13. Particulate and sulfur dioxide emissions were calculated using EPA emission factors and average sulfur contents of fuels as reported by NADB. These factors and the resulting estimated emissions are shown in Table 2-13.

Subcounty Apportionment

The county total particulate and sulfur dioxide emissions were apportioned into the twelve natural grids on the basis of population within each grid.

2.2.3.2 Commercial/Institutional Fuel

County Totals

The quantities of fuel used by commercial and institutional area sources as estimated from the fuel dealer survey

TABLE 2-13. EMISSIONS FROM RESIDENTIAL FUEL USE - HENDERSON COUNTY

Fuel	Quantity Burned	Emission Factor		% S[3]	Emissions (tons/year)	
		Particulate	SO_2		Particulate	SO_2
Natural Gas[1]	$1270 \times 10^6 ft^3$	$10^{lb}/10^6 ft^3$	$0.6^{lb}/10^6 ft^3$		6.4	0.4
Liquid Petroleum Gas[2]	$2200 \times 10^3 gal$	$1.85^{lb}/10^3 gal$	$0.014^{lb}/10^3 gal$		2.0	neg
Distillate Oil[1]	$570 \times 10^3 gal$	$2.5^{lb}/10^3 gal$	$144S^{lb}/10^3 gal$	0.1	0.7	4.1
Residual Oil	0	$16.5^{lb}/10^3 gal$	$159S^{lb}/10^3 gal$	1.7	0	0
Anthracite Coal	0	$10.0^{lb}/ton$	$36.8S^{lb}/ton$	0.6	0	0
Bituminous Coal	1040 tons	$20^{lb}/ton$	38S	1.2	10.4	23.7
Wood	0				0	0
TOTAL					19.5	28.2

[1] Values from 1972 NADB information

[2] Values from fuel survey

[3] % S = sulfur percentage

and NADB data are shown in Table 2-14. The estimated emissions were calculated using EPA emission factors and are also shown in Table 2-14.

Subcounty Apportionment

The county total emissions as described above were apportioned into the twelve natural grids on the basis of 1974 grid population.

2.2.3.3 Industrial Fuel

County Totals

The method used to estimate county total industrial area source fuel use differed from the method used for the other two categories in this county in that it was possible that a significant portion of the fuel sales were to industrial point sources. If the value determined by the fuel dealer survey greatly exceeded the NADB value, therefore, the NADB value was felt to be more accurate and was used. In additon, since no data was supplied by the natural gas dealers in Henderson County, the NADB value was used. The fuel use estimates along with emissions calculated with EPA emissions are shown in Table 2-15.

Subcounty Apportionment

The county total industrial fuel use emissions were apportioned into the twelve natural grids on the basis of manufacturing employment within each grid.

TABLE 2-14. COMMERCIAL/INSTITUTIONAL AREA SOURCES EMISSIONS - HENDERSON COUNTY

Fuel	Quantity Burned	Emission Factor		Emissions (tons/year)	
		Particulate	SO_2	Particulate	SO_2
Natural Gas [1]	410x10^6ft^3	10 lb/10^6ft^3	0.6 lb/10^6ft^3	2.1	0.1
LPG [2]	125x10^3gal	1.85 lb/10^3gal	0.014 lb/10^3gal	0.1	neg
Distillate Oil [2,3]	240x10^3gal	15 lb/10^3gal	14.4 lb/10^3gal	1.8	1.7
Residual Oil [1]	200x10^3gal	23 lb/10^3gal	270.3 lb/10^3gal	2.3	27.0
Anthracite Coal	0			0	0
Bituminous Coal [1]	0			0	0
TOTAL				6.3	28.8

[1] NADB data used

[2] Fuel survey data used

[3] Emission factor based on 0.1% sulfur

[4] Emission factor based on 1.7% sulfur

TABLE 2-15. INDUSTRIAL FUEL USE AREA SOURCE EMISSIONS - HENDERSON COUNTY

Fuel	Quantity Burned	Emission Factor		Emissions (tons/year)	
		Particulate	SO_2	Particulate	SO_2
Natural Gas[1]	$330 \times 10^6 ft^3$	$10\ lb/10^6 ft^3$	$0.6\ lb/10^6 ft^3$	1.7	0.1
LPG[2]	$125 \times 10^3 gal$	$1.85 \times 10^3 gal$	$0.014\ lb/10^3 gal$	0.1	neg
Distillate Oil[1,3]	$330 \times 10^3 gal$	$15\ lb/10^3 gal$	$144S\ lb/10^3 gal$	2.5	2.4
Residual Oil[1,4]	$660 \times 10^3 gal$	$23\ lb/10^3 gal$	$159S\ lb/10^3 gal$	7.6	89.2
Anthracite Coal[1,2]	0	-	-	0	0
Bituminous Coal[1,2]	0	-	-	0	0
TOTAL				11.9	91.7

[1] Data from NADB for 1972

[2] Data from fuel survey

[3] Based on 0.1% sulfur

[4] Based on 1.7% sulfur

2.3 Highway Vehicles

2.3.1 Vanderburgh County

County Totals

This category includes the emissions caused by fuel combustion on all roads (paved and unpaved) by all types of vehicles. In order to determine the quantity of these emissions, it was necessary to find the total vehicle miles traveled (VMT) on all roads in the county. The Evansville Urban Transportation Study (EUTS) provided the necessary data on the Vanderburgh County paved roads. These data consisted of annual VMT for each of the approximately 280 traffic zones in Vanderburgh County for the time period 1974-1975. To obtain daily VMT for each zone, updated traffic counts were applied to expressway, arterial, and collector roads identified by EUTS. Then VMT for the remaining local street-mileage in each zone was estimated using average traffic counts. The total daily VMT from major and local roads for each zone was multiplied times 365 to obtain annual VMT.

The data for unpaved roads was in the form of road lengths and AADT's for each township. The VMT for each unpaved road segment was found by the following equation:

Road Segment Length x AADT x 365 = Annual VMT

The total 1974 VMT was found to be 1.006 billion with the paved roads accounting for more than 99.9% of the total. The VMT and emissions for paved and unpaved roads are shown in Table 2-16. It was assumed that the county vehicle mix conformed to the national average for 1974. See Table 2-17.

TABLE 2-16. VANDERBURGH COUNTY HIGHWAY FUEL EMISSION

		Particulates		Sulfur Oxides	
Road Type	VMT	Emission Factor [1]	Emissions (Tons/year)	Emission Factor	Emissions (Tons/year)
Paved	1,005,512,500	0.60 ^{g}/mi	664.4	0.23 ^{g}/mi	254.7
Unpaved	208,616	0.60 ^{g}/mi	0.1	0.23 ^{g}/mi	0.1
TOTAL	1,005,721,116		664.5		254.8

[1] Emission factor accounts for fuel combustion and tire wear

TABLE 2-17 ASSUMED VEHICLE MIX

Vehicle Type	% of VMT
Automobiles	80.4
Light Trucks	11.8
Heavy Gasoline Trucks	4.6
Heavy Diesel Trucks	3.2

Source: Environmental Protection Agency, Compilation of air pollutant emission factors, 2nd ed., with supplements. AP-42. Research Triangle Park, N.C., April 1973.

Subcounty Apportionment

The VMT for each traffic zone was apportioned into census tract grids as follows. First, the VMT for each traffic zone which fell entirely within a census tract was assigned to the appropriate census tract. Next, VMT for traffic zones which overlapped a census tract boundary was apportioned into the census tracts based on the fraction of traffic zone area in each census tract. Since the traffic zones generally fell entirely within a census tract, only about fifteen percent had to be apportioned. The total VMT for each census tract grid is shown in Table 2-18.

TABLE 2-18. VEHICLE MILES OF TRAVEL BY GRID - VANDERBURGH COUNTY

Census Tract Grid	Annual VMT (10^6)	Census Tract Grid	Annual VMT (10^6)
1	22.1	24	19.5
2	32.2	25	6.4
3	19.5	26	7.7
4	11.0	27	72.6
5	5.5	28	39.8
6	5.2	29	2.4
7	18.3	30	11.4
8	16.8	31	9.0
9	24.1	32	9.3
10	18.0	33	41.1
11	13.3	34	38.8
12	2.9	35	11.9
13	2.2	36	7.0
14	5.8	37	48.5
15	6.2	38	17.8
16	1.4	39	6.2
17	1.3	101	35.1
18	9.4	102	151.4
19	8.3	103	9.2
20	6.0	104	29.9
21	9.2	105	18.8
22	133.9	106	3.6
23	9.4	107	23.5

2.3.2 Daviess County

County Totals

The number of vehicle miles traveled (VMT) by vehicles in Daviess County in 1974 were found for two basic categories: 1) the Owensboro urban area and 2) the remainder of Daviess County. The VMT data for the Owensboro area was supplied by the IAPCD in the form of SAPOLUT transportation data. The VMT for the remainder of the county was determined from road maps supplied by the Kentucky Department of Transportation. These maps contained data on daily traffic counts (ADT) for major roads and road lengths for local roads. The equation used to obtain VMT data from these maps is as follows:

Road length (miles) x ADT x 365 = annual VMT

Since actual ADT was not available for some local roads, an average value of 100 was assumed. The methods which were used to determine unpaved road VMT are described in Section 2.6.2.

The vehicle mix for these roads was assumed to conform to the national average. The quantity of emissions which were generated by this vehicular traffic were estimated with EPA emission factors. A summary of the data used and emission estimates is shown in Table 2-19. As a check of these values, the data derived by the above methods was compared to similar data reported by NADB for 1970. This analysis showed that the 1970 NADB values were 6.7% smaller than the derived 1974 values.

TABLE 2-19. HIGHWAY VEHICLE EMISSIONS - DAVIESS COUNTY

Road Classification	Road Length (miles)	Annual VMT (10^6)	Emission Factor (g/mi) Particulate[3]	Emission Factor (g/mi) SO_2	Emissions (TPY) Particulate	Emissions (TPY) SO_2
Owensboro Area	---	306.6	0.6	0.23	202.6	77.7
U.S. Highways & Major State Roads	169.5	116.2	0.6	0.23	76.8	29.4
Other State Roads	166.1	34.8	0.6	0.23	23.0	8.8
Local Roads with ADT	117.2	10.0	0.6	0.23	6.6	2.5
Local Roads without ADT						
Paved[1]	242	8.8	0.6	0.23	5.8	2.2
Unpaved[2]	153	0.8	0.6	0.23	0.5	0.2
TOTAL		477.2			315.3	120.8

---

[1] ADT assumed to equal 100

[2] ADT assumed to equal 15

[3] Emission factor accounts for combustion and tire wear

Subcounty Apportionment

The county total VMT were apportioned into the grids in the following manner:

1) Owensboro area - The Central Business District and Central City VMT, as determined from SAPOLLUT data, were apportioned equally into grids 705, 706, 707, and 708. The Suburban VMT were divided evenly into grids 701, 702, 703, 704, 709, 710, 711, and 712.

2) Remainder of the county - The paved road VMT were apportioned into grids 100 through 600 and 800 through 1400 on the basis of grid area. The unpaved road VMT were apportioned by road location.

Emissions for each grid were then calculated using the emission factors previously reported in Table 2-19. A summary of the grid VMT is shown in Table 2-20 for all roads. The breakdown between paved and unpaved roads is shown in Tables 2-73 and 2-74.

2.3.3 Henderson County

County Totals

The vehicular traffic in Henderson County was determined for two basic areas: 1) Henderson metropolitan area, and 2) the remainder of Henderson County. The data for the urban area was supplied by IAPCD. This data consisted of daily vehicle miles traveled (VMT) by functional classification (e.g., arterial, collector, etc.) as determined from the urban transportation study. The data for the remainder of the county consisted of road maps with vehicle counts (ADT) for the major roads. An ADT

TABLE 2-20. GRID VMT[1] - DAVIESS COUNTY

Grid	VMT (10^4)
100	589
200	589
300	589
400	2356
500	2346
600	2350
701	2304
702	2304
703	2304
704	2304
705	3055
706	3055
707	3055
708	3055
709	2304
710	2305
711	2304
712	2305
800	2351
900	588
1000	2355
1100	2354
1200	263
1300	263
1400	66

[1] Includes paved and unpaved roads

of 100 was assumed for the paved roads without vehicle count data and an ADT of 15 was assumed for the unpaved roads. The equation which was used to calculate annual VMT from this data is as follows:

Road length (miles) x ADT x 365 = annual VMT

The methods which were used to determine unpaved road VMT are discussed further in Section 2.6.3.

The vehicle mix for these roads was assumed to conform to the national average. The quantity of particulate and SO_2 emissions which were generated by this vehicular traffic was estimated with EPA emission factors. A summary of the data used and the emission estimates is shown in Table 2-21. The VMT determined by these methods were compared to the 1972 NADB data and it was found that the NADB county total was 7.0% smaller than the 1974 calculated value.

Subcounty Apportionment

The VMT were apportioned into grids within the two areas for which values were determined. The VMT within the Henderson metropolitan area were apportioned by road length into grids 201, 202, 203, 204, 205, 206N and 206S. The VMT for the remainder of the county were apportioned by road length into grids 207N, 207S, 208, 209N and 209S. A summary of the apportioned VMT is shown in Table 2-22.

TABLE 2-21. HIGHWAY VEHICLE EMISSIONS - HENDERSON COUNTY

	Road	Annual	Emission Factor (g/mi)		Emissions (TPY)	
Road Classification	Length (mile)	VMT (10^6)	Particulate	SO_2	Particulate	SO_2
Henderson Area	---	141.0	0.6	0.23	93.2	35.7
Remainder of County						
U.S. Highways & Major State Roads	74.5	116.5	0.6	0.23	77.0	29.5
Other State Roads	99.6	47.3	0.6	0.23	31.3	12.0
Local Paved Roads[1]	251	9.2	0.6	0.23	6.1	2.3
Local Unpaved Roads[2]	229	1.3	0.6	0.23	0.9	0.3
TOTAL		314.8			208.5	79.8

---

[1] ADT of 100 assumed

[2] ADT of 15 assumed

TABLE 2-22. APPORTIONED VEHICULAR TRAFFIC - HENDERSON COUNTY[1]

Grid	VMT (10^6)
201	16.9
202	19.7
203	11.3
204	15.5
205	21.2
206N	31.0
206S	25.4
207N	45.6
207S	26.3
208	48.9
209N	27.9
209S	26.4

---

[1] Includes paved and unpaved roads

2.4 Fuels - Off Highway

2.4.1 Vanderburgh County

2.4.1.1 Railroad Engines

County Totals

Railroad activity data was obtained in the form of a count of the number of road hauling trains passing each major railroad - highway crossing in the urban area of the county. This activity data was tabulated within the National Railroad - Highway Crossing Inventory as developed by the U.S. Department of Transportation and the Indiana Highway Commission.[1] This data was used to determine the average number of trains per day which traveled along the railway lines. Table 2-23 shows the railroad activity for each major railway and the location of the activity. This data was used along with the length of track to determine the total number of train-miles in Vanderburgh County in 1974. A factor of 7.8 gallons per train-mile was used to calculate the quantity of diesel fuel used. The county fuel use calculated for the road hauling train-miles was then compared to county usage estimated in the 1972 NADB area source file. The difference between the NADB estimate and the road hauling consumption was assumed to be fuel used by switching engines.

Emissions were calculated, using EPA emission factors. A summary of the results of this analysis is shown below in Table 2-24.

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[1] Shah, Harshad R., Private Communication, Indiana State Highway Commission, 9 June 1977.

Subcounty Apportionment

The county total particulate and SO_2 emissions from road-hauling engines were apportioned into the natural grids on the basis of activity within each grid by the following equation:

$$\frac{(\text{train-miles per day})\ \text{grid}}{(\text{train-miles per day})\ \text{county}} \times \begin{matrix}\text{County total}\\ \text{emissions}\end{matrix} = \begin{matrix}\text{grid}\\ \text{emissions}\end{matrix}$$

TABLE 2-23. VANDERBURGH COUNTY RAILROAD ACTIVITY

Railroad	Location	Average Trains/Day
Louisville & Nashville	South of Evansville	28
Louisville & Nashville	West of Evansville	16
Illinois Central	Northwest of Evansville	0
New York Central	Northwest of Evansville	8
Chicago and Eastern Illinois	North of Evansville	12
New York Central	Northeast of Evansville	2
Southern	East of Evansville	0
Chicago & Eastern Illinois	South of Evansville	0

Railroad activities within each grid were found by determining the length of each rail line within each grid and applying the trains per day data discussed previously.

Emissions from switching operations were assigned to grids as shown in Table 2-24.

TABLE 2-24. RAILROAD EMISSIONS VANDERBURGH COUNTY

Activity		1974 Fuel Use (10^3 gal)	Emission Factors ($lb/10^3$ gal)		Emissions (TPY)	
			Particulate	SO_2	Particulate	SO_2
Road Hauling						
629.4*	$\frac{\text{train-miles}}{\text{day}}$	1,792*	25	57	22.4	51.1
Census Tract	Switching					
29	L&N Yard	402			5.0	11.5
31	L&N Yard	402			5.0	11.5
102	Chicago & E. Illinois	804			10.1	22.9
		3,400**			42.5	97.0

*Calculated from NRHCI data and 7.8 gals per train-mile.
**NADB area source county estimate.

2.4.1.2 Vessels

The emissions considered in this section are particulates and sulfur dioxide generated by the combustion of distillate and residual fuel oil in commercial vessels along the Ohio River. Since the emissions generated by pleasure craft, such as small outboard powered vessles, are very small compared to the commercial vessels, they will not be considered.

The quantity of fuel burned by vessels on the Ohio River along the Vanderburgh County boundary was determined as follows:

1. The total number of trips made by vessels along the entire length of the Ohio River from the mouth of the river to Pittsburgh, Pennsylvania, was determined to be 68,975 in 1974.[1]

2. The number of trips in Vanderburgh County was found by assuming that the number of trips were evenly distributed along the river and apportioning the total by length of river as follows:

$$68{,}975 \text{ trips} \times \frac{34 \text{ miles (Vanderburgh Co.)}}{981 \text{ miles (total length)}} = 2391 \text{ trips in Vanderburgh County}$$

3. The percent of total fuel use which was distillate oil and the percent residual oil were determined

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[1] U.S. Army Corps of Engineers, Army Engineer Div., Lower Mississippi Valley, Vicksburg, Miss., Waterborne Commerce of the United States, Calendar year 1974, pts. 1-5, New Orleans, U.S. Army Engineer District, New Orleans.

from values reported in Mineral Industry Survey.[1] That is, since all the bunkering in Indiana was on the Ohio River (information from IAPCD) and a major portion of the bunkering in Kentucky was on the Ohio River, the split between distillate and residual marine fuel sales for these two states was assumed to be the same as that used adjacent to Vanderburgh County. A summary of this sales data is shown below in Table 2-25.

4. Total fuel usage adjacent to Vanderburgh County was then calculated, based on EPA fuel use factors of 19 gallons of distillate oil per mile and 44 gallons of residual oil per mile. In addition, since the Ohio River borders Vanderburgh County, the total fuel use was divided by two. The equations used, therefore, were as follows:

Distillate Oil Use:

$$2391 \text{ trips} \times \tfrac{1}{2} \times 0.79 \times \frac{19 \text{ gal}}{\text{mile}} \times \frac{34 \text{ mile}}{\text{trip}} = 610{,}111 \text{ gallons}$$

Residual Oil Use:

$$2391 \text{ trips} \times \tfrac{1}{2} \times 0.21 \times \frac{44 \text{ gal}}{\text{mile}} \times \frac{34 \text{ mile}}{\text{trip}} = 375{,}578 \text{ gallons}$$

5. Emissions were calculated from this fuel usage based on EPA emission factors and are reported below in Table 2-26.

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[1] U.S. Bureau of Mines, Div. of Fuels Data, Sales of Fuel Oil and Kerosine in 1974. Mineral Industry Surveys, Fuel Oil Sales Annual. Washington, D.C., Sept. 1975.

TABLE 2-25. STATE TOTAL MARINE FUEL USAGE - 1974

Fuel Type	Bunkering (10^3 gal) Indiana	Kentucky	Total (10^3 gal)	Percent of Total Fuel Use
Distillate Oil	788	218	1006	79%
Residual Oil	261	2	263	21%

TABLE 2-26. COMMERCIAL VESSEL EMISSIONS VANDERBURGH COUNTY

Fuel Type	Fuel Use (10^3 gal)	Emission Factor ($lb/10^3$ gal) Particulate	SO_2	Emissions (TPY) Particulate	SO_2
Distillate Oil	610	24	30	7.3	9.2
Residual Oil	376	19.3	286	3.6	53.8
TOTAL				10.9	63.0

Subcounty Apportionment

The county total emissions were apportioned into the grids located along the Ohio River on the basis of river length within each grid. The river lengths used are reported below in Table 2-27 for each natural grid located on the Ohio River.

2.4.1.3 Aircraft

County Totals

The particulate and SO_2 emissions described here were generated by fuel usage during aircraft landings and takeoffs. The number of landing-takeoff (LTO) cycles for Dress Regional Airport in 1974 was reported as 92,733. A breakdown by type of operation for these LTO's and the emissions generated by each is shown in Table 2-28. Emissions were calculated on the basis of the LTO data and EPA emission factors.

Subcounty Apportionment

The emissions generated by aircraft at Dress Regional Airport were put into grid where the airport is located.

2.4.1.4 Farm Tractors

County Totals

The county total emissions generated by fuel combustion by farm tractors in Vanderburgh County were determined by the methods and data supplied by the Department of Agricultural Engineering at Purdue University. The data which was used in this analysis is summarized in Table 2-29. The emissions were

TABLE 2-27. RIVER LENGTH BY GRIDS VANDERBURGH COUNTY

Grid	River Length (miles)
17	0.75
18	0.75
28	0.75
29	0.85
31	1.0
101	10.0
104	20.0
TOTAL	34.0

TABLE 2-28 EVANSVILLE DRESS REGIONAL AIRPORT: AIRCRAFT EMISSIONS

Aircraft Type	LTO's	Number of Engines	Emission Factor lb/engine - LTO		Emissions (TPY)	
			Particulate	SO_2	Particulate	SO_2
Air Carrier (large jet)	10,784	2.5[1]	1.1	0.4	14.8	5.4
Air Taxi (turbo-prop)	1,417	2	1.1	0.4	1.6	0.6
Military	35,058	1[2]	0.31	0.76	5.4	13.3
Civil Operations	51,977	1	0.02	0.014	0.5	0.4
Local Operations	24,997	1	0.02	0.014	0.2	0.2
TOTAL	124,233				22.5	19.9

---

[1] Basis: 50% two engine aircraft (DC-9) and 50% three engine aircraft (Boeing 727).

[2] Basis: Single engine military jet.

TABLE 2-29 VANDERBURGH COUNTY FARM TRACTOR FUEL USE DATA

Crop Type	% Fuel Use[1]		Fuel Requirement (gal/acre)[1]		Acres	Fuel Use (10^3gal)	
	Gasoline	Diesel	Gasoline	Diesel		Gasoline	Diesel
Corn	27	73	11.4	8.4	33,628[2]	103.5	206.2
Soybeans	25	75	10.4	7.6	30,251[2]	78.6	172.4
Wheat	31	69	5.6	4.2	14,938[2]	25.9	43.3
Oats	39	61	3.9	2.9	300[3]	0.5	0.5
Hay	50	50	4.3	3.1	3,300[3]	7.1	5.1
TOTAL					82,417	215.6	427.5

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[1] Source: Department of Agricultural Engineering, Purdue University.

[2] Source: Soil Conservation Service.

[3] Source: Statistical Reporting Service, United States Department of Agriculture.

calculated on the basis of county total fuel use and EPA emission factors and are shown in Table 2-30.

TABLE 2-30 VANDERBURGH COUNTY TOTAL FARM TRACTOR EMISSIONS

Fuel	Fuel Use (10^3gal)	Emission Factor Particulate	Emission Factor SO_2	Emissions (TPY) Particulate	Emissions (TPY) SO_2
Gasoline	215.6	8.0	5.31	0.9	0.6
Diesel	427.5	45.7	31.2	9.8	6.7
TOTAL	643.1			10.7	7.3

Subcounty Apportionment

The county total emissions generated by fuel use by farm tractors was apportioned into grids based on the area of agricultural land in each grid. This data is reported below in Table 2-31 for each natural grid with significant agricultural land.

2.4.1.5 Construction Equipment

County Totals

The quantity of fuel used by construction equipment in Vanderburgh County in 1974 was determined for diesel powered equipment and gasoline powered equipment. The diesel usage was determined on the basis of an average fuel use of 5,000 gallons per nonbuilding construction (NBC) employee per year (Volume 7 of Guidelines for Air Quality Maintenance Planning and Analysis). The number of NBC employees was reported in

TABLE 2.31. AGRICULTURAL LAND LOCATION VANDERBURGH COUNTY

Natural Grid	Land Area (Acres)	Percent of County Total Agricultural Land
2	716	0.8
10	441	0.5
30	450	0.5
32	500	0.6
36	511	0.6
37	366	0.4
38	560	0.6
101	10,753	12.0
102	9,905	11.1
103	550	0.6
104	20,283	22.7
105	9,299	10.4
106	15,901	17.8
107	19,036	21.3
TOTAL	89,271	100.0

County Business Patterns[1] as 474 for Vanderburgh County. The total diesel for use for 1974, therefore, is found as follows:

5,000 gal/NBC employee/yr x 474 NBC employees = 2370 x 10^3 gal

The county total gasoline use was determined by apportioning state total gasoline use for construction activities into Vanderburgh County on the basis of the number of NBC employees. This method and the data used is shown below in the following equation:

$$1{,}940 \times 10^3 \text{ gal (state total)} \times \frac{948 \text{ NBC employees (county)}}{28{,}588 \text{ NBC employees (state)}} =$$

$$64.3 \times 10^3 \text{ gal}$$

The emissions which were generated by this fuel use were calculated on the basis of EPA emission factors. A summary of these emissions and factors are shown in Table 2-32.

TABLE 2-32 EMISSIONS FROM CONSTRUCTION EQUIPMENT VANDERBURGH COUNTY

Fuel	Fuel Use (10^3gal)	Emission Factor (lb/10^3gal) Particulate	Emission Factor (lb/10^3gal) SO_2	Emissions (TPY) Particulate	Emissions (TPY) SO_2
Diesel	2,370	30.1	31.1	35.7	36.9
Gasoline	64.3	10.7	5.6	0.4	0.2
TOTAL				36.1	37.1

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[1] U.S. Department of Commerce, Bureau of the Census, County Business Patterns 1974, Indiana. CBP-74-16. Washington, D.C., GPO, January 1977.

Subcounty Apportionment

The county total emissions were apportioned into the grids on the basis of construction employment within each grid in 1970.

2.4.1.6 Miscellaneous Off Highway Fuel Use

County Totals

This category includes the quantity of gasoline and diesel used in all other off highway activities. The gasoline use was determined on the basis of 13 gallons per person per year and the diesel use was determined on the basis of 7.4 gallons per person per year (Volume 7 of Guidelines for Air Quality Maintenance Planning and Analysis). The emissions were calculated on the basis of EPA emission factors and are reported in Table 2-33.

TABLE 2-33. EMISSIONS FROM MISCELLANEOUS OFF HIGHWAY FUEL USE
VANDERBURGH COUNTY

Fuel	1974 Fuel Use (10^3gal)	Emission Factors (lb/10^3gal)		Emissions (TPY)	
		Particulate	SO_2	Particulate	SO_2
Diesel	1,284	33.3	29.8	21.4	19.1
Gasoline	2,255	10.8	5.26	12.2	5.9
TOTAL				33.6	25.0

Subcounty Apportionment

The emissions which were generated by the fuel use in this category were apportioned into grids on the basis of 1974 population within each grid.

2.4.2 Daviess County

2.4.2.1 Railroad Engines

County Totals

The emissions described in this section are generated by the use of diesel oil in railroad engines in Daviess County. Since no train counts were available for this area, county total fuel use as reported by the National Air Data Branch of the USEPA were used. Emissions were calculated from this data based on EPA emission factors. A summary of the data used and the emissions calculated is shown below in Table 2-34.

TABLE 2-34 RAILROAD EMISSIONS - DAVIESS COUNTY

Fuel Use (10^3gal)	Emission Factor (lb/10^3gal)		Emissions (TPY)	
	Particulate	SO_2	Particulate	SO_2
1880	25	57	23.5	53.6

Subcounty Apportionment

The county total emissions were apportioned into the natural grids on the basis of the length of track within each grid. A summary of these track lengths is shown in Table 2-35.

TABLE 2-35 RAILROAD TRACK LOCATIONS - DAVIESS COUNTY

Natural Grid Number	Length of Railroad Track (miles)
100	0
200	0
300	4.6
400	0
500	9.8
600	9.5
701	1.0
702	7.6
703	0
704	3.3
705	1.2
706	0
707	2.3
708	1.9
709	1.3
710	2.7
711	0
712	0
800	7.6
900	0
1000	0
1100	7.9
1200	0
1300	0
1400	0
TOTAL	60.7

2.4.2.2 Vessels

County Totals

The total quantities of distillate and residual oil that were burned by commercial vessels along the Ohio River in 1974 were determined by the method previously described for Vanderburgh County in Section 2.4.1.2. A summary of the data used for this county is as follows:

River length in Daviess County: 30 miles
Vessel trips in Daviess County: 2109 trips
Percent distillate oil : 79%
Percent residual oil : 21%
Distillate oil useage : 19 gal per mile
Residual oil useage : 44 gal per mile

The county total fuel use and emissions that were calculated using this data and EPA emission factors are shown below in Table 2-36.

TABLE 2-36 COMMERCIAL VESSEL EMISSIONS - DAVIESS COUNTY

Fuel Type	Fuel Use (10^3gal)	Emission Factor (lb/10^3gal)		Emissions (TPY)	
		Particulate	SO_2	Particulate	SO_2
Distillate Oil	427	24	30	5.1	6.4
Residual Oil	292	19.3	286	2.8	41.8
TOTAL	719			7.9	48.2

Subcounty Apportionment

The county total emissions generated by commercial vessels in 1974 were apportioned into the natural grids which are adjacent to the Ohio River on the basis of river mileage within each grid. The river length within each of these grids is shown in Table 2-37.

TABLE 2-37 OHIO RIVER LENGTH - DAVIESS COUNTY

Natural Grid	River Length (Miles)
600	10.0
701	3,5
709	4.5
710	4.0
1100	8.0
TOTAL	30.0

2.4.2.3 Aircraft

County Totals

The emissions described in this section are generated by fuel use during aircraft landings and takeoffs at Daviess County Airport. The number of landing-takeoff cycles at this airport in 1974 was supplied by IAPCD and is shown in Table 2-38. Emissions were calculated with EPA emission factors and are shown on the same table.

TABLE 2-38 AIRCRAFT EMISSIONS - DAVIESS COUNTY AIRPORT

Aircraft Type	Number of Engines	Landing-Take Off Cycles	Emission Factors (lb/engine-LTO)		Emissions (TPY)	
			Particulate	SO_2	Particulate	SO_2
Twin Jet	2	8,008	1.1	0.4	8.8	3.2
Light Twin Engine	2	18,684	0.02	0.014	0.4	0.3
Single engine	1	26,692	0.02	0.014	0.3	0.2
TOTAL		53,384			9.5	3.7

Subcounty Apportionment

The particulate and SO_2 emissions generated by the aircraft at Daviess County Airport were apportioned into the grids where the airport is located.

2.4.2.4 Farm Tractors

County Totals

The particulate and SO_2 emissions discussed in this section were generated by the consumption of diesel and gasoline by farm tractors during agricultural operations. The number of acres which were subjected to the various operations was supplied by the IAPCD. The split between diesel and gasoline powered tractors and the fuel requirements were supplied by Purdue University. A summary of this data and the resulting fuel use is shown in Table Table 2-39. Emissions were calculated from this data with EPA emission factors. The calculated emissions and the factors used are shown in Table 2-40.

Subcounty Apportionment

The grid emissions were calculated from crop acreages and fuel use factors by the same method described above for the county totals. The grids with significant agricultural activity were located through information supplied by the local Extension Agent. The county total agricultural land acreage was then apportioned into these grids on the basis of grid area. The resulting acreages by crop for each grid are shown in Table 2-41. These crop acreages were then used in conjunction with the diesel/gasoline distribution

TABLE 2-39 DAVIES COUNTY FARM TRACTOR FUEL USE DATA

Crop Type	% Fuel Use		Fuel Requirement (gal/acre)			Fuel Use (10^3gal)	
	Gasoline	Diesel	Gasoline	Diesel	Acres	Gasoline	Diesel
Corn	27	73	11.4	8.4	46,702	143.7	286.6
Soybeans	25	75	10.4	7.6	90,598	235.4	516.2
Wheat	31	69	5.6	4.2	20,000	34.4	57.2
TOTAL					157,300	413.4	860.0

TABLE 2-40 FARM TRACTOR EMISSIONS - DAVIESS COUNTY

Fuel	Fuel Use (10^3gal)	Emission Factor Particulate	Emission Factor SO_2	Emissions (TPY) Particulate	Emissions (TPY) SO_2
Gasoline	413.4	8.0	5.31	1.7	1.1
Diesel	860.0	45.7	31.2	19.7	13.4
TOTAL	1273.4			21.4	14.5

and fuel use factors reported in Table 2-39 to determine fuel use within each grid. This data is shown in Table 2-42. Particulate and SO_2 emissions within each grid were calculated using EPA emission factors and the fuel use within each grid.

TABLE 2-41 CROP ACREAGE WITHIN EACH NATURAL GRID WITH SIGNIFICANT AGRICULTURAL ACTIVITY - DAVIESS COUNTY

	Crop Acreage			
Grid	Corn	Soybeans	Wheat	Total
400	7,185	13,938	3,077	24,200
500	7,185	13,938	3,077	24,200
600	7,185	13,938	3,077	24,200
800	7,185	13,938	3,077	24,200
900	1,796	3,485	769	6,050
1000	7,185	13,938	3,077	24,200
1100	7,185	13,938	3,077	24,200
1200	798	1,549	354	2,689
1300	798	1,549	354	2,689
1400	200	387	88	672
TOTAL	46,702	90,598	20,000	157,300

TABLE 2-42 1974 FUEL USE WITHIN EACH GRID BY CROP DAVIESS COUNTY

	Gasoline Use (10 gal)			Diesel Use (10^3gal)			Total (10^3gal)	
Grid	Corn	Soybeans	Wheat	Corn	Soybeans	Wheat	Gasoline	Diesel
400	22.1	36.2	5.3	44.1	79.4	8.8	63.6	132.3
500	22.1	36.2	5.3	44.1	79.4	8.8	63.6	132.3
600	22.1	36.2	5.3	44.1	79.4	8.8	63.6	132.3
800	22.1	36.2	5.3	44.1	79.4	8.8	63.6	132.3
900	5.5	9.1	1.3	11.0	19.9	2.2	15.9	33.1
1000	22.1	36.2	5.3	44.1	79.4	8.8	63.6	132.3
1100	22.1	36.2	5.3	44.1	79.4	8.8	63.6	132.3
1200	2.4	4.0	0.6	4.9	8.8	1.0	7.1	14.7
1300	2.4	4.0	0.6	4.9	8.8	1.0	7.1	14.7
1400	0.7	1.1	0.1	1.2	2.3	0.2	1.7	3.7
TOTAL	143.6	235.4	34.4	286.6	516.2	57.2	413.4	860.0

2.4.2.5 Construction Equipment

County Total

The quantity of fuel used by construction equipment in Daviess County in 1974 was determined for diesel powered equipment on the basis of an average fuel use of 5,000 gallons per nonbuilding construction (NBC) employee per year (Volume 7 of Guidelines for Air Quality Maintenance Planning and Analysis). The number of NBC employees was reported in County Business Patterns[1] as 381 for Daviess county. The total diesel use for 1974, therefore, is found as follows:

5,000 gal/NBC employee/yr x 381 NBC employees = 1905 x 10^3gal

The emissions which were generated by this fuel use were calculated on the basis of EPA emission factors. A summary of these emissions and factors are shown in Table 2-43.

TABLE 2-43 EMISSIONS FROM CONSTRUCTION EQUIPMENT - DAVIESS COUNTY

Fuel	Fuel Use (10^3gal)	Emission Factor (lb/10^3gal) Particulate	Emission Factor (lb/10^3gal) SO_2	Emissions (TPY) Particulate	Emissions (TPY) SO_2
Diesel	1,905	30.1	31.1	28.7	29.6

Subcounty Apportionment

The county total emissions were apportioned into the grids on the basis of 1974 population within each grid.

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[1] U.S. Department of Commerce, Bureau of the Census, County Business Patterns 1974, Kentucky, CBP-74-19, Washington, D.C., November 1976.

2.4.2.6 Miscellaneous Off Highway Fuel Use

County Totals

This category includes the quantity of gasoline and diesel used in all other off highway activities. The gasoline use was determined on the basis of 13 gallons per person per year and the diesel use was determined on the basis of 7.4 gallons per person per year (Volume 7 of Guidelines for Air Quality Maintenance Planning and Analysis). The emissions were calculated on the basis of EPA emission factors and are reported in Table 2-44.

TABLE 2-44 EMISSIONS FROM MISCELLANEOUS OFF HIGHWAY FUEL USE DAVIESS COUNTY

Fuel	1974 Fuel Use (10^3gal)	Emission Factors (lb/10^3gal)		Emissions (TPY)	
		Particulate	SO_2	Particulate	SO_2
Diesel	613	33.3	29.8	10.2	9.1
Gasoline	1,077	10.8	5.26	5.8	2.8
TOTAL				16.0	11.9

Subcounty Apportionment

The emissions which were generated by the fuel use in this category were apportioned into grids on the basis of 1974 population within each grid.

2.4.3 Henderson County

2.4.3.1 Railroad Engines

County Totals

The emissions described in this section are generated by the use of diesel oil in railroad engines in Henderson County. Since no train counts were available for this area, county total fuel use as reported by the National Air Data Branch of the U.S. EPA were used. Emissions were calculated from this data based on EPA emission factors. A summary of the data used and the emissions calculated is shown below in Table 2-45.

TABLE 2-45

RAILROAD EMISSIONS - DAVIESS COUNTY

FUEL USE (10^3 Gal)	EMISSION FACTOR ($lb/10^3$ Gal)		EMISSIONS (TPY)	
	Particulate	SO_2	Particulate	SO_2
860	25	57	10.8	24.5

Subcounty Apportionment

The county total emissions were apportioned into the natural grids on the basis of the length of track within each grid. A summary of these track lengths is shown in Table 2-46.

2.4.3.2 Vessels

County Totals

The total quantities of distillate and residual oil that were burned by commercial vessels along the Ohio River

TABLE 2-46

RAILROAD LOCATION, HENDERSON COUNTY

Grid	Track Length (Miles)
201	0
202	2.3
203	0
204	0.3
205	0
206N	2.1
206S	3.4
207N	8.6
207S	3.6
208	10.7
209N	7.0
209S	9.1
	47.1

in 1974 were determined by the method previously described for Vanderburgh County in Section 2.4.1.2. A summary of the data used for this county is as follows:

River length in Henderson County	59 miles
Vessel trips in Daviess County	4148 trips
Percent distillate oil	79%
Percent residual oil	21%
Distillate oil useage	19 gal per mile
Residual oil useage	44 gal per mile

The county total fuel use and emissions that were calculated using this data and EPA emission factors are shown below in Table 2-47.

TABLE 2-47

COMMERCIAL VESSEL EMISSIONS - DAVIESS COUNTY

Fuel Type	Fuel Use (10^3 gal)	Emissions Factor ($lb/10^3$ Gal)		Emissions (TPY)	
		Particulate	SO_2	Particulate	SO_2
Distillate oil	1837	24	30	22.0	27.6
Residual Oil	1131	19.3	286	10.9	161.7
TOTAL	2968			32.9	189.3

Subcounty Apportionment

The county total emissions generated by commercial vessels in 1974 were apportioned into the natural grids which are adjacent to the Ohio River on the basis of river mileage within each grid. The river length within each of these grids is shown in Table 2-48.

TABLE 2-48

OHIO RIVER LENGTH - DAVIESS COUNTY, KENTUCKY

Natural Grid	River Length (Miles)
201	0.8
204	1.2
206N	1.0
206S	2.0
207N	30
209N	24
TOTAL	59.0

2.4.3.3. Aircraft

County Totals

The emissions reported in this section were generated by fuel used by aircraft at Henderson Airport in 1974. Since no local data was available on the number of landing-takeoff cycles at this airport in 1974, NADB values were used. A summary of this data and the resulting emissions are reported below in Table 2-49.

TABLE 2-49

AIRCRAFT EMISSIONS - HENDERSON AIRPORT

Aircraft Type	Number of Engines	Landing-Takeoff Cycles	Emission Factors (lb/engine-LTO) Particulate	Emission Factors (lb/engine-LTO) SO_2	Emissions (TPY) Particulate	Emissions (TPY) SO_2
Military	-	0	-	-	0	0
Civilian	1	23,930	0.02	0.014	0.2	0.2
Commercial	2	1,770	1.1	0.49	1.0	0.4
TOTAL		25,700			1.2	0.6

Subcounty Apportionment

The emissions generated by this fuel use were apportioned into the grids where the airport is located.

2.4.3.4. Farm Tractors

County Totals

The emissions reported in this section were generated by the use of diesel and gasoline in farm tractors during the agricultural operations in Henderson County in 1974. The data which was used to determine this fuel use is shown below in Table 2-50. An example of the method used to determine fuel use from the above data is shown below for gasoline useage in operations associated with the growing of corn:

$$58{,}500 \text{ acres} \times 11.4 \text{ gal/acre} \times 0.30 = 200.0 \times 10^3 \text{gal}$$

The particulate and SO_2 emissions which were generated by this fuel use were calculated using EPA emission factors.

TABLE 2-50

FARM TRACTOR FUEL USE DATA - HENDERSON COUNTY

Crop	1974[1] Acres	Fuel Use Factor (Gal/Acre)[2] Gasoline	Diesel	Percent of Tractors by Fuel[3] Gasoline	Diesel	Fuel Use (10^3 Gal) Gasoline	Diesel
Corn	58,500	11.4	8.4	30	70	200.0	344.0
Soybeans	71,500	10.4	7.6	30	70	223.1	380.4
Wheat	13,000	5.6	4.2	30	70	21.8	38.2
TOTAL	143,000					444.9	1112.6

---

[1] Data supplied by Henderson County Extension Agent.

[2] Data supplied by Dept. of Agricultural Engineering, Purdue University.

[3] Data supplied by Kentucky DAP.

These factors along with the calculated emissions are shown in Table 2-51.

TABLE 2-51

FARM TRACTOR EMISSIONS - HENDERSON COUNTY

Fuel	Fuel Use (10 Gal)	Emission Factor (10^3 Gal) Particulate	SO_2	Emissions (TPY) Particulate	SO_2
Gasoline	444.9	8.0	5.31	1.8	1.2
Diesel	1112.6	45.7	31.2	25.4	17.4
TOTAL	1557.5			27.2	18.6

equipment on the basis of an average fuel use of 5,000 gallons per nonbuilding construction (NBC) employee per year (Vol. 7 of Guidelines for Air Quality Maintenance Planning and Analysis). The nu,-ber of NBC employees was reported in County Business Patterns[1] as 46 for Henderson County. The total diesel use for 1974, is shown in Table 2-52.

TABLE 2-52

DIESEL FUEL FROM CONSTRUCTION EQUIPMENT HENDERSON COUNTY

5,000 gal/NBC employee/yr x 46 NBC employees = 230 x 10^3gal

The emissions where were generated by this fuel use were calculated on the basis of EPA emission factors. A summary of these factors and the resulting emissions are shown below in Table 2-53.

TABLE 2-53

EMISSIONS FROM CONSTRUCTION EQUIPMENT - HENDERSON COUNTY

Diesel Use (10^3 Gal)	Emission Factor ($lb/10^3$ Gal) Particulate	Emission Factor ($lb/10^3$ Gal) SO_2	Emissions (TPY) Particulate	Emissions (TPY) SO_2
230	30.1	31.1	3.5	3.6

Subcounty Apportionment

The county total emissions were apportioned into the grids on the basis of 1974 population.

2.4.3.5 Miscellaneous Off Highway Fuel Use

County Totals

This category includes the quantity of gasoline and diesel used in all other off highway activities. The gasoline use was determined on the basis of 13 gallons per person per year and the diesel use was determined on the basis of 7.4 gallons per person per year (Volume 7 of Guidelines for Air Quality Maintenance Planning and Analysis). The emissions were calculated on the basis of EPA emission factors and are reported in Table 2-54.

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[1] U.S. Department of Commerce, Bureau of the Census, County Business Patterns 1974, Kentucky, CBP-74-19, Washington, DC, GPO, Nov. 1976.

TABLE 2-54

EMISSIONS FROM MISCELLANEOUS OFF HIGHWAY FUEL USE - HENDERSON COUNTY

Fuel	1974 Fuel Use (10^3 Gal)	Emission Factors ($lb/10^3$ Gal) Particulate	SO_2	Emissions (TPY) Particulate	SO_2
Diesel	280	33.3	29.8	4.7	4.2
Gasoline	491	10.8	5.26	2.7	1.3
TOTAL				7.4	5.5

Subcounty Apportionment

The emissions which were generated by the fuel use in this category were apportioned into grids on the basis of 1974 population within each grid.

2.5 Solid Waste Disposal

2.5.1 Vanderburgh County

2.5.1.1 Incineration

County Totals

The emissions reported in this section are those that were generated by incineration at residential, commercial/institutional and industrial facilities in Vanderburgh County. The quantity of material burned by incineration was determined for the following two areas: 1) Evansville metropolitan area, and 2) remainder of Vanderburgh County.

The quantity of material incinerated within the Evansville area was found by an analysis of incineration permits supplied by the Evansville EPA. The quantity burned in the remainder of the county was determined on the basis of methods suggested by Volume 7 of the AQMA Guidelines. These suggested methods are summarized below in the following equations:

Residential inceneration:

$$40\ \frac{\text{tons burned}}{\text{1,000 Pop.-yr}} \times \frac{\text{population}}{\text{1,000}} = \text{tons burned}$$

Commercial/institutional inceneration:

$$50\ \frac{\text{tons burned}}{\text{1,000 pop.-yr}} \times \frac{\text{area source C/I incineration}}{\text{point + area source incineration}} \times \frac{\text{population}}{\text{1,000}}$$

$$= \text{area source quantity burned (TPY)}$$

Industrial incineration:

$$\frac{\text{335 tons burned}}{\text{1,000 mfg. employees-yr}} \times \frac{\text{manufacturing employees}}{\text{1,000}} = \text{tons burned}$$

The population of the area outside Evansville was determined to be 28,739 (see section 2.1 for further discussion of 1974 population). The total number of manufacturing employees in Vanderburgh County in 1974 was 29,368. Since, however, 81% of these employees were within the Evansville area (from Bureau of Census data), only 5,580 of these employees were in the area outside Evansville.

The emissions which were generated by this incineration were calculated with EPA emission factors. A summary of the quantity burned and emissions generated is shown in Table 2-55.

Subcounty Apportionment

The county total incineration emissions for the Evansville area were apportioned into the grids within Evansville. The remaining emissions were apportioned into the grids outside the Evansville area. The methods used are as follows:

1) Residential emissions: Apportioned on the basis of 1974 population for all areas.

2) Commercial/Institutional: Apportioned on the basis of 1974 population for all areas.

3) Industrial: The emissions generated by the sources within the Evansville area were apportioned into the grid on the basis of facility location. The emissions for the remainder of the county were apportioned by manufacturing employment.

TABLE 2-55. INCINERATION EMISSIONS - VANDERBURGH COUNTY

	Quantity Burned (tons)					Comm/Inst &		Emissions (TPY)					
				Residential		Industrial		Residential		Comm/Inst		Industrial	
Area	Residential	Comm/Inst	Industrial	TSP	SO_2	TSP	SO_2	TSP	SO_2	TSP	SO_2	TSP	SO_2
Evansville	133	1,967	151	32.0	5.0	8.0	2.5	2.1	0.3	7.9	2.5	0.6	0.2
Remainder of County	1,150	1,437	1,869	32.0	5.0	8.0	2.5	18.4	2.9	5.7	1.8	7.5	2.3
TOTAL	1,283	3,404	2,020					20.5	3.2	13.6	4.3	8.1	2.5

2.5.1.2 Open Burning

County Totals

The residential, commercial/institutional, and industrial open burning emissions within Vanderburgh county were determined for two areas: 1) Evansville plus four miles beyond city limit and 2) remainder of the county. This basis was used since open burning without a permit is not allowed within Evansville or four miles beyond the city limits. The data on permits issued for this area was supplied by the Evansville EPA. This data was in the form of volume of material burned and type of material burned. Quantities burned were determined from this data on the basis of the following densities:

1) 2 lb/ft^3 for limbs, brush and bushes

2) 45 lb/ft^3 for solid wood

Once the total burned within this regulated area had been determined from the permits, it was apportioned into the three general categories (residential, commercial/institutional and industrial) on the basis of totals calculated using factors from Volume 7 of the AQMA Guidelines. That is, the total quantity burned was also calculated by factors and the split between the categories by this method was used to apportion the data from the permits. The factors which were used within this analysis are 122 tons burned per 1,000 persons for residential open burning, 12 tons per 1,000 persons for commercial/institutional sources and 160 tons per 1,000 manufacturing employees for industrial sources.

The category split by this method was determined to be 79.8% residential, 7.8% commercial/institutional and 12.4% industrial.

The quantities burned within the remainder of the county were determined on the basis of the activity factors listed above. The particulate and SO_2 emissions which were generated by open burning within these two areas were determined with EPA emission factors. A summary of the quantities burned, factors used and emissions generated is shown in Table 2-56.

Subcounty Apportionment

The county total emissions were apportioned into the grids for the three categories by the following methods:

1) Residential emissions: were apportioned into the grids on the basis of population within the grids contained in each of the two areas.

2) Commercial/Institutional emissions: were apportioned into the grids on the basis of population within the grids in each of the two areas.

3) Industrial emissions: were apportioned into the grids on the basis of manufacturing employment within each grid in each of the two areas.

TABLE 2-56. OPEN BURNING EMISSIONS - VANDERBURGH COUNTY

	Quantity Burned (tons)			Emission Factor(lb/ton)		Emissions (TPY)					
						Residential		Comm/Inst		Industrial	
Area	Residential	Comm/Inst	Industrial	TSP	SO_2	TSP	SO_2	TSP	SO_2	TSP	SO_2
Evansville + Four Miles Beyond	414	41	64	16	1	3.3	0.2	0.3	neg	0.5	neg
Remainder of County	871	86	200	16	1	7.0	0.4	0.8	neg	1.6	0.1
TOTAL	1,285	127	264			10.3	0.6	1.1	neg	2.1	0.1

2.5.2 Daviess County

2.5.2.1 Incineration

County Totals

The quantities of material burned by on-site incineration at residential, commercial/institutional and industrial facilities in 1974 were determined on the basis of factors suggested by Volume 7 of the AQMP Guidelines. These factors are listed below for each type of incineration:

Residential: 40 tons burned per 1000 people.

Commercial/Institutional: 50 tons burned per 1000 people

Industrial: 335 tons burned per 1000 manufacturing employees.

The population and employment data which was used with these factors are discussed in Section 2.1. The particulate and SO_2 emissions which were generated by this combustion were determined with EPA emission factors. A summary of the factors used and the results of this analysis is shown in Table 2-57.

Subcounty Apportionment

The county total particulate and SO_2 emissions generated by these sources were apportioned into the grids by the following methods:

1) Residential emissions: apportioned on the basis of 1974 grid population.

TABLE 2-57. INCINERATION EMISSIONS - DAVIESS COUNTY

Category	Quantity Burned (Tons)	Emission Factors (lb/ton)		Emissions (TPY)	
		Particulate	SO_2	Particulate	SO_2
Residential	3372	32.0	5.0	53.9	8.4
Commercial/ Institutional	4220	8.0	2.5	16.9	5.2
Industrial	2687	8.0	2.5	10.8	3.4

2) Commercial/institutional emissions: apportioned on the basis of 1974 grid population.

3) Industrial emissions: apportioned into the grids on the basis of manufacturing employment.

5.2.2.2 Open Burning

County Totals

The emissions discussed in this section are the particulate and SO_2 emissions generated by open burning in Daviess County in 1974. The quantity of emissions within this category was estimated for the following two areas: 1) within the Owensboro city limits, and 2) the remainder of Daviess County. This division was made since regulations prohibit open burning within the city limits. Compliance with this regulation was assumed. The amount of solid waste which was burned in 1974 was determined on the basis of the following factors:

1) Residential burning 122 tons per 1000 people.

2) Commercial/institutional burning: 12 tons per 1000 people.

3) Industrial burning: 160 tons per 1000 manufacturing employees.

The emissions which were generated by this burning were estimated on the basis of EPA emission factors. A summary of the results of this analysis is shown in Table 2-58. The emissions presented in this table are those occurring in the area outside Owensboro. The emissions within the Owensboro city limits are zero for all categories.

TABLE 2-58. OPEN BURNING EMISSIONS - DAVIESS COUNTY

Category	Quantity Burned (Tons)	Emission Factor (lb/ton) Particulate	Emission Factor (lb/ton) SO_2	Emissions (TPY) Particulate	Emissions (TPY) SO_2
Residential	4946	16.0	1.0	39.6	2.5
Commercial/ Institutional	486	16.0	1.0	3.8	Neg.
Industrial	1433	16.0	1.0	11.4	0.7
TOTALS	6865			54.8	3.2

Subcounty Apportionment

The county total estimated emissions were apportioned into the grids by the following methods:

1) Residential emissions: These emissions were apportioned into the grids on the basis of 1974 population. Only the population in areas outside the Owensboro city limits were considered. The population data was supplied by the Indiana Air Pollution Control Division in the form of zone population for 93 zones for 1972 and 1995. This data was developed as part of the Owensboro Urban Area Transportation Study. Data for 1974 was determined by interpolation. In addition to this data, the population within the areas of Daviess County outside the transportation study was determined (see Section 2.1). (The population within the CDM grids which were partially inside the Owensboro city limits was found on the basis of the transportation study zones which were in the CDM grid but outside Owensboro.) In the cases where the transportation study zone was partially inside Owensboro, the population was apportioned on the basis of zone area outside the city.

2) Commercial/institutional emissions: The emissions within this category were apportioned on the basis of grid population. The population was determined by the method discussed above.

3) Industrial emissions: The emissions within this category were apportioned into the grids on the basis of manufacturing employment. The grid employment was determined in the same manner as the grid population discussed for residential emissions apportionment.

2.5.3 Henderson County

2.5.3.1 Incineration

County Totals

The quantities of material burned by on-site incineration at residential, commercial/institutional and industrial facilities in 1974 were determined on the basis of factors suggested by Volume 7 of the AQMP Guidelines. These factors are listed below for each type of incineration:

Residential: 40 tons burned per 1000 people.

Commercial/institutional: 50 tons burned per 1000 people.

Industrial: 335 tons burned per 1000 manufacturing employees.

The population and employment data which was used with these factors are discussed in Section 2.1. The particulate and SO_2 emissions which were generated by this combustion were determined with EPA emission factors. A summary of the factors used and the results of this analysis is shown in Table 2-59.

Subcounty Apportionment

The county total particulate and SO_2 emissions generated by these sources were apportioned into the grids by the following methods:

1) Residential emissions: apportioned on the basis of 1974 grid population.

TABLE 2-59. INCINERATION EMISSIONS - HENDERSON COUNTY

		Emission Factors (lbs/ton)		Emissions (TPY)	
Category	Quantity Burned (Tons)	Particulate	SO_2	Particulate	SO_2
Residential	1512	32.0	5.0	24.2	3.8
Commercial/ Institutional	1890	8.0	2.5	7.6	2.3
Industrial	684	8.0	2.5	2.5	1.2

2) Commercial/institutional emissions: apportioned on the basis of 1974 grid population.

3) Industrial emissions: apportioned into the grids on the basis of manufacturing employment.

5.2.3.2 Open Burning

County Totals

The emissions discussed in this section are the particulate and SO_2 emissions generated by open burning in Henderson County in 1974. The quantity of emissions within this category was estimated for the following two areas: 1) within the Henderson city limits, and 2) the remainder of Henderson County. This division was made since regulations prohibit open burning within the city limits. Compliance with this regulation was assumed. The amount of solid waste which was burned in 1974 was determined on the basis of the following factors:

1) Residential burning: 122 tons per 1000 people.

2) Commercial/institutional burning: 12 tons per 1000 people

3) Industrial burning: 160 tons per 1000 manufacturing employees.

The emissions which were generated by this burning were estimated on the basis of EPA emission factors. A summary of the results of this analysis is shown in Table 2-60. The emissions presented in this table are those occurring in the area outside the city of Henderson. The emissions within the Henderson city limits are zero for all categories.

TABLE 2-60. OPEN BURNING EMISSIONS - HENDERSON COUNTY

Category	Quantity Burned (Tons)	Emission Factor (lb/ton) Particulate	SO_2	Emissions (TPY) Particulate	SO_2
Residential	1943	16.0	1.0	15.4	1.0
Commercial/ Institutional	191	16.0	1.0	1.5	Neg.
Industrial	138	16.0	1.0	1.1	Neg.
TOTAL	2272			18.0	1.0

Subcounty Apportionment

The county total emissions were apportioned into the grids outside the Henderson city limits. Since the census tract grids which were used coincided very closely with the city limits, the following grids were virtually entirely within the city and were assumed to have no open burning: 201, 202, 203, 204, 205, 206N and 206S. The emissions therefore were apportioned into the remaining five grids on the following basis:

1) Residential emissions: apportioned on the basis of 1974 population.

2) Commercial/institutional emissions: apportioned on the basis of 1974 population.

3) Industrial emissions: apportioned on the basis of manufacturing employments.

2.6 Fugitive Dust Sources

2.6.1 Vanderburgh County, Indiana

2.6.1.1 Agricultural Tilling

County Totals

The emissions of particulates caused by agricultural tilling were calculated based on an emission factor found from the following equation:[1]

$$E = \frac{1.4\ s}{\left(\frac{PE}{50}\right)^2}$$

where: E = an emission factor for particulates in lb/acre.
s = silt content of soil (%)
PE = Thornwaites precipitation-evaporation index (PE= 107 within Vanderburgh County)

Since the percent silt in the soil varied across the county, an emission factor was developed for each grid on the basis of the average silt content within that grid. The average silt content for each grid was calculated on the basis of the land area within each grid for each soil type. That is, a weighted silt content was found by the following equation:

$$\frac{\text{Total of (\% silt x land area) for all soil types in the grid}}{\text{total grid land area}} = \text{weighted silt content (\%)}$$

The data for this analysis were taken from a soil map (Figure 2-7)

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[1] Environmental Protection Agency, Compilation of Air Pollutant Emission Factors, 2nd Edition with Supplements. AP-42. Research Triangle Park, N.C., February 1972, April 1973, July 1973, Sept 1973, July 1974, Jan 1975, Dec 1975, Feb 1976.

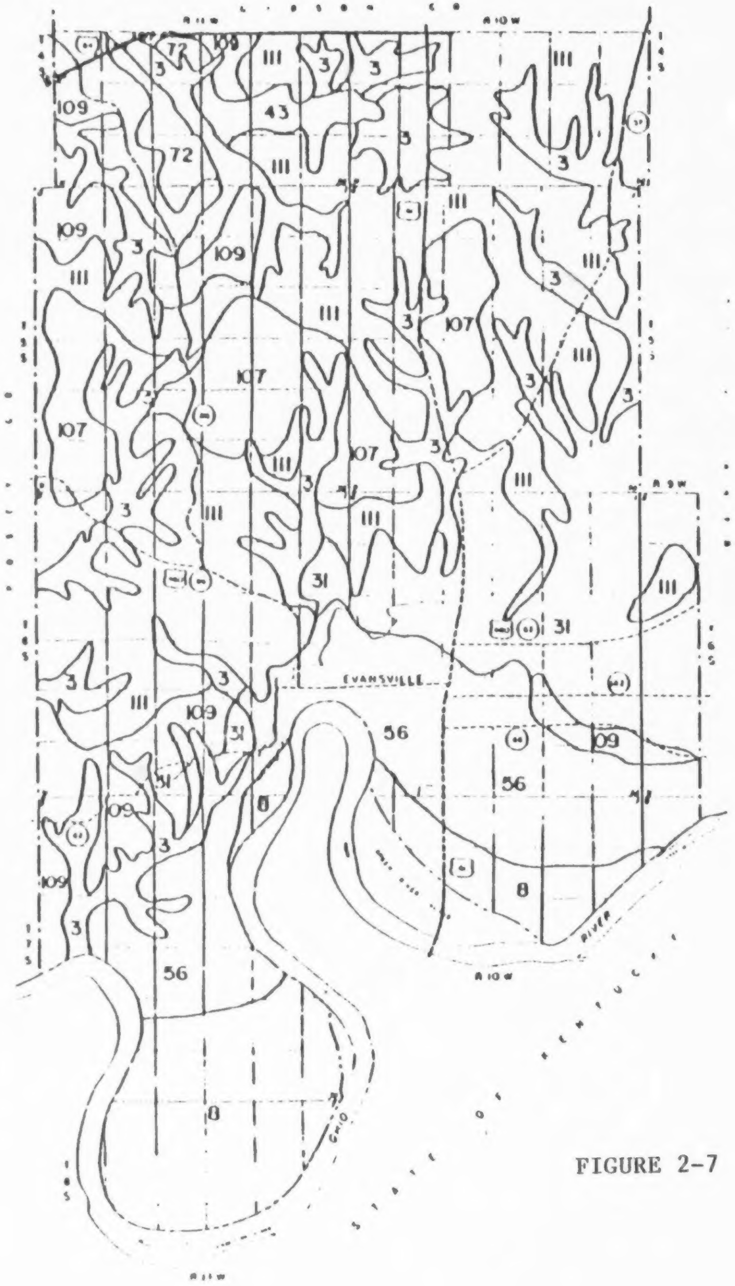
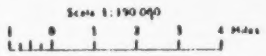


FIGURE 2-7

VANDERBURGH COUNTY

GENERAL SOIL MAP

Agricultural Experiment Station and Cooperative Extension Service, Purdue University; and the Soil Conservation Service, U.S. Department of Agriculture



Base map from the Indiana Geological Society

Note: This map is intended for general planning. Each delineation contains soils different from those shown in the legend. For operational planning, use detailed soil maps that may be available in published or unpublished form at the local Soil and Water Conservation District Office.

SOIL ASSOCIATIONS

3. Wakeland-Stendal-Haymond-Bartle: Nearly level, somewhat poorly drained, silty Wakeland and Stendal and well-drained, silty Haymond in alluvial deposits, and somewhat poorly drained, silty Bartle with fragipans in acid alluvial deposits.
8. Huntington-Lindside: Nearly level, well drained, silty Huntington and moderately well drained, silty Lindside in alluvial deposits.
31. McGary: Nearly level, somewhat poorly drained, clayey soils on lake deposits.
43. Patton-Henshaw: Nearly level, very poorly drained, silty Patton and somewhat poorly drained, silty Henshaw in lake deposits.
56. Weinbach-Sciotoville: Nearly level, somewhat poorly drained, loamy Weinbach and moderately well drained, loamy Sciotoville, both with fragipans, on outwash sand, gravel, and silt.
72. Reesville-Ragsdale: Nearly level, somewhat poorly drained, silty Reesville and very poorly drained, silty Ragsdale in windblown silts.
107. Zanesville-Wellston: Sloping, well drained, silty Zanesville with fragipans and silty Wellston in windblown siltes and weathered shale and sandstone.
109. Alford: Sloping, well drained, silty soils in windblown silts.
111. Hosmer: Sloping, well drained, silty soils with fragipans in windblown silts.

and silt contents for each soil (Table 2-61) as supplied by the Indiana Air Pollution Control Department.

TABLE 2-61. SILT CONTENT BY SOIL TYPE

Soil Association Number	Silt Content of Surface Soil (%)
3	69
8	69
31	69
43	69
56	65
72	69
107	61
109	56
111	56

The total number of acres tilled in 1974 were based on the number of acres of each crop harvested and the number of times each acre was tilled. These data are shown in Table 2-62.

TABLE 2-62. NUMBER OF ACRES TILLED (1974)

Crop	Acres Harvested[1]	No. of Tillings	Acres Tilled
Corn	33,628[1]	3.5	117,698
Soybeans	30,251[1]	2	29,876
Wheat	14,938[1]	3.5	105,879
Oats	300[2]	2	600
Hay	3,300[2]	2	6,600
Total	82,417		260,653

[1] Supplied by: Evansville EPA

[2] Supplied by: U.S. Dept. of Agriculture, Statistical Reporting Service, Purdue University

The emissions generated by this tilling activity were determined on the grid level due to variation in crop type and soil characteristics between the grids. This determination, therefore, is discussed in more detail in the following section on Subcounty Apportionment. The county total was determined by summing the grid level emissions and is as follows:

1974 Particulate Emissions: 2511.9 tons

Due to the nature of the activity which generated these emissions, no SO_2 emissions were produced.

Subcounty Apportionment

Since the emissions within this category were determined on the grid level, apportionment was not necessary. The following discussion, therefore, relates to emission determination.

The first step in determining these emissions was to develop an emission factor for each grid which had agricultural activites. It was assumed for this analysis that the metropolitan Evansville area had no significant agricultural activity. This area included the following grids (census tracts): 001, 003-009, 011-029, 031. The emission factors for the remainder of the county were determined by the methods discussed in the previous section.

The second step in this analysis was determining the acres tilled within each grid. This was determined on the basis of Township data supplied by the Evansville EPA for grids (census tracts) 102, 103, 104, 105, 106 and 107. The data for the remaining grids consisted of an area total since the grid size is smaller than the Township size for which data was available.

The Township total, therefore, was apportioned into these grids on the basis of population density. That is, it was assumed that agricultural activity was inversely proportional to population density.

The emission factors, acres, tilled, and resulting emissions appear in Table 2-63.

2.6.1.2 Construction Activities

County Totals

The quantity of dust emissions caused by equipment at construction sites is dependent on the number of areas which were under construction in 1974 and the duration of each construction project. The size and location of each major building project in the county was estimated by the Evansville Building Commissioner. Since, however, no data was available on the duration of each project, a three month per year period of dust producing activities was assumed for each project.

The emissions generated by this activity were calculated on the basis of the general factor of one ton per acre month adjusted for Vanderburgh County as follows:

1) The general factor is based on the following conditions:
   Soil silt content (S) = 30%
   Thornwaites precipitation-evaporation index (PE)=50

2) The average conditions in Vanderburgh County are as follows:
   S = 65%
   PE = 107

TABLE 2-63. AGRICULTURAL TILLING EMISSIONS[1]

Grid (Census Tract)	Acres Tilled	Emission Factor (lb/acre)	Particulate Emissions (TPY)
002	2,510	21.1	26.5
010	1,550	19.9	15.4
030	1,379	19.9	13.7
032	1,347	19.9	13.4
036	1,796	19.9	17.9
037	1,284	19.9	12.8
038	1,963	19.9	19.5
101	27,485	20.1	276.2
102	31,455	19.0	298.8
103	1,694	19.9	16.9
104	58,227	19.6	570.6
105	28,604	18.6	266.0
106	43,099	19.6	422.4
107	58,260	18.6	541.8
TOTAL	260,653		2,511.9

---

[1] The grids not listed in this table are within the Evansville metropolitan area and are assumed to have no significant agricultural tilling activity.

3) Since this type of dust emission has been found to be directly proportional to S and inversely proportional to the square of PE, the general factor was adjusted by the following method:

$$\text{Vanderburgh County Emission Factor} = 1\ \frac{\text{ton}}{\text{acre-month}} \times \left(\frac{65}{30}\right) / \left(\frac{107}{50}\right)^2$$

$$= 0.47 \text{ tons per acre-month}$$

The county total activity and particulate emissions which were determined by these methods is as follows:

1974 Construction Acreage: 289 acres

1974 Particulate Emissions: 407.5 tons

Subcounty Apportionment

The quantity of fugitive dust which was produced in each grid was determined based on the construction activity in that grid as estimated by the Building Commissioner. The type of project and acres involved for each grid with significant construction activity in 1974 is shown in Table 2-64. As with the county total, the duration of dust-creating activities for each project was assumed to be three months.

TABLE 2-64

LOCATION AND SIZE OF CONSTRUCTION PROJECTS - VANDERBURGH COUNTY

Grid	Project Type	Acreage
2	United States Armory	10
2	Industrial	3
9	Apartments	10
10	Shopping Center	8
11	Subdivision	10
15	Skating Rink	5
24	Golf Course	75
30	City park and convenience center	10
31	Warehouse	10
32	Apartments	10
33	Demolition, renovation	10
34	Swimming pool	10
37	Retirement home	5
38	Apartments	10
102	Motel	3
102	Industrial	10
103	Industrial	15
103	University addition	20
105	Landfill	30
107	Subdivision	25
TOTAL		289

2.6.1.3 Highway Vehicles - Unpaved Roads

County Totals

The suspended particulates discussed in this section are generated by vehicular travel over unpaved road surfaces. The quantity of emissions generated by this travel is primarily dependent upon the vehicle miles of travel (VMT) on the unpaved roads. The VMT on these roads was calculated by the following equation:

$$\text{VMT} = \text{road length} \times \text{AADT} \times 365.$$

The data for this calculation was provided by the IAPCD in the form of a map and tabular listing showing road location, road length and AADT (annual average daily traffic). An emission factor for this vehicular traffic was developed for Vanderburgh County from the following equation:[1]

$$E = (0.59\ s)\ \left(\frac{S}{30}\right)\ \left(\frac{365-W}{365}\right)$$

where: E = emission factor in lb/VMT

s = silt content (%) of road surface

S = vehicle speed (mph)

W = days with greater than 0.01 in. of rain in 1974.

The percent silt (s) used in this equation was 12. This value is based on the assumption that all these roads are gravel. The speed of the vehicles on these unpaved roads is between 30 and 50 mph.[1] An average value of 40 mph was used for each grid. The number of days with more than 0.01 inches of rain was determined to be 129 in 1974 (data supplied by the Indiana Department of Air Pollution Control). The emission factor which was developed by this method is 6.1 lb/VMT. The county total VMT was determined to be 208,616 for 1974. The emissions, therefore, are calculated as follows:

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[1] Environmental Protection Agency, Compilation of Air Pollutant Emission Factors, 2nd Edition with Supplements, AP-42, Research Triangle Park, NC, Feb 1972, April 1973, July 1973, Sept 1973, July 1974, Jan 1975, Dec 1975, Feb 1976.

$$\text{Particulate Emissions} = 6.1 \text{ lb/VMT} \times 208{,}616 \text{ VMT} \times \frac{\text{ton}}{2000 \text{ lb}}$$

$$= 636 \text{ tons}$$

Subcounty Apportionment

The county total particulate emissions were apportioned into the grids with unpaved roads on the basis of VMT within each grid. This grid VMT is summarized in Table 2-65.

TABLE 2-65

UNPAVED ROAD VMT WITHIN EACH GRID - VANDERBURGH COUNTY

Grid	VMT
101	26,061
102	16,370
104	101,361
105	7,063
106	32,026
107	21,735
TOTAL	208,616

2.6.1.4 Highway Vehicles - Paved Roads

County Totals

The emissions reported in this section are suspended particulates caused by entrainment of dust as vehicles travel on paved roads. The VMT data which was used is the same data that was discussed previously in Section 2.3.1. Particulate emissions were calculated from this VMT data on the basis of an emission factor of 1 gram TSP per VMT. A summary of the data used and the emissions calculated is shown below:

1974 VMT = 1,005,721,116

1974 Particulate Emissions = 1107.4 tons

Subcounty Apportionment

The county total particulate emissions were apportioned into the grids on the basis of VMT within each grid. The method used to determine this VMT was discussed in Section 2.3.1 and the gridded VMT are shown in Table 2-18.

2.6.1.5 Aggregate Storage Piles

It was assumed for the basis of this analysis that any major emission from aggregate storage facilities was accounted for as a point source. The area source emissions, therefore, are negligible.

2.6.1.6 Windblown Dust: Soil Erosion from Agricultural Fields

County Totals

The emissions which are considered in this section are particulate emissions caused by wind blowing across bare land. As with some of the previous sections of this report which addressed fugitive dust, the emissions vary with soil type and were therefore calculated on the grid level to account for variations in soil type from one area to another. The county total, therefore, is the sum of the grid emissions.

The emissions were calculated on the basis of the following wind erosion equation:[1,2]

$$E = IKCL'V'$$

where: E = an emission factor for total wind erosion (ton/acre/yr). It should be noted that this represents total wind erosion and not just suspended particulates. An adjustment of E to account for this will be discussed subsequently in this section.

I = soil erodibility index (tons/acre/yr). This factor is a measure of maximum soil erodibility under worst conditions. The subsequent terms serve to reduce this index.

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[1] Cowherd, Chatten, Jr., et al., Development of Emission Factors for Fugitive Dust Sources, Final Report. EPA-450/3-74-037, Contract No. 68-02-0619. Kansas City, MO., Midwest Research Inst., June, 1974.

[2] Woodruff, N. P. and F. H. Siddoway, "A Wind Erosion Equation," Soil Science Society of America, Proc. 29(5), 602-08 (1965).

K = roughness factor (dimensionless). This factor takes into account surface roughness which tends to dissipate wind energy and trap particulates.

C = Climatic factor. This parameter relates soil erodibility to meteorological conditions.

L' = unsheltered field width factor (dimensionless). This parameter is a function of actual field width (L) and soil erodibility (I).

V' = vegetative cover factor (dimensionless). This parameter is a function of actual quantities of crop residue left on a field while it is bare (V) in lb/acre, roughness factor (K), field width factor (L') and climatic factor (C).

The value used for I within each grid was calculated as a weighted I on the basis of the area of each soil association within each grid. The I value for each soil association was found by assuming an equal distribution of land area between each soil series within the association. The value of I for each soil series and the calculated I for each soil association is shown in Table 2-66. The weighted I for each grid was determined by the following equation:

$$\frac{\text{Total of (I x land area) for each soil association}}{\text{Total grid land area}} = \text{weighted I}$$

The land areas of each soil association in each grid was determined from the general soil map (see Figure 2-1). The weighted I for each grid is shown in Table 2-68.

TABLE 2-66

SOIL ERODIBILITY - VANDERBURGH COUNTY

Soil Association	Soil Series	Soil Series[1] Erodibility (ton/acre-yr)	Soil Association Erodibility (ton/acre-yr)
3	Wakeland	56	64
	Stendal	56	
	Haymond	56	
	Bartle	86	
8	Huntington	56	56
	Lindside	56	
31	McGary	56	56
43	Patton	38	47
	Henshaw	56	
56	Weinbach	56	56
	Scotoville	56	
72	Reesville	56	56
	Ragsdale	56	
107	Zonesville	56	56
	Wellston	56	
109	Alford	56	56
111	Hosmer	56	56

---

[1] U.S. Department of Agriculture, Soil Conservation Service, Indiana State Office, Wind Erosion, Tech. Note, Agronomy #21, Indianapolis, Inc., March 1973.

The climatic factor (C) was calculated on the basis of the following equation:

$$C = 0.345 \frac{W^3}{(PE)^2}$$

where: W = mean annual wind velocity

PE = Thornwaite's precipitation-evaporation index.

The nine year average wind speed for this part of Indiana was found to be 9.5 mph[1] and PE was determined to be 107.[3] On this basis, C was found to be 0.0258 or 2.58%.

The typical values of K, L, and V were reported by crop type and are shown in Table 2-67. The values of L' and V' were found graphically[3] based on the reported values of K, L, V and the weighted I for each grid. Based on these calculated values, E was calculated for each crop type for each grid. A weighted emission factor for each grid was then calculated based on the harvested average of each crop type as reported by the U.S. Department of Agriculture. The equation used was as follows:

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[1] Chepil, W. S., et al., "Climatic Factor for Estimating Wind Erodibility of Farm Fields," Journal of Soil and Water Conservation, 17 (4), 163 (1962).

[2] Environmental Protection Agency, Compilation of Air Pollutant Emission Factors, 2nd Edition with Supplements, AP-42, Research Triangle Park, NC, Feb 1972, April 1973, July 1973, Sept 1973, July 1974, Jan 1975, Dec 1975, Feb 1976.

[3] Cowherd, Chatten, Jr., et al., Development of Emission Factors for Fugitive Dust Sources, Final Report, EPA-450/3-74-037, Environmental Protection Agency, Contract No. 68-02-0619, Kansas City, MO, Midwest Research Inst., June 1974.

$$\text{Weighted Emission Factor (WEF)} = \sum \left[E_{crop} \times \frac{\%crop}{100} \text{ ton/acre/year} \right]$$

The emission factor thus developed for total wind erosion (WEF) was then adjusted to calculate only the total suspended particulates (TSP) on the basis of the assumption that 2.5% of the total wind erosion became TSP.[1] The suspended particulate emission factor (SPF) was therefore calculated as follows:

$$\text{SPF} \frac{\text{tons}}{\text{acre-yr}} = \text{WEF} \frac{\text{tons eroded}}{\text{acre-yr}} \quad \frac{0.025 \text{ tons suspended}}{\text{tons eroded}} \times \frac{2000 \text{ lb}}{\text{ton}}$$

The SPF values thus calculated for each grid are reported in Table 2-68.

TABLE 2-67

WIND EROSION PARAMETERS BY CROP TYPE

Crop	K	L(ft.)	V lb/acre)
Corn	0.6	2000	500
Soybeans	0.6	2000	250
Wheat	0.6	2000	1350
Oats	0.8	2000	1250
Hay	0.8	2000	1250

The suspended particulate emissions within each grid were calculated by using the acres harvested (U.S. Department of Agriculture) and the assumption that the fields are barren three months out of the year. The emissions equation, therefore, is as follows:

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[1] Cowherd, Chatten, Jr., et al., Development of Emission Factors for Fugitive Dust Sources, Final Report, EPA-450/3-74-037, Environmental Protection Agency Contract No. 68-02-0619, Kansas City, MO, Midwest Research Inst., June 1974.

$$\text{Total Suspended Particulates (tons/yr)} = \text{SPF} \times \text{acres} \times \frac{\text{ton}}{2000\,\text{lb}} \times \frac{3}{12}$$

The emissions for each grid thus calculated are shown in Table 2-68. The county total emissions were found to be 215.2 tons in 1974 from the 82,447 acres of agricultural land.

Subcounty Apportionment

Since the county total emissions were calculated on the grid level, there was no subcounty apportionment needed. Emission factors for total suspended particulates and annual grid emissions, however, are reported in Table 2-68.

TABLE 2-68

WINDBLOWN DUST EMISSIONS - VANDERBURGH COUNTY*

Grid	Weighted Erodibility (I) ton/acre-yr	Agricultural Land (Acres)	Emission Factor (lb/acre-yr)	Particulate Emissions (tons)
2	56	772	5.25	2.03
10	56	477	5.25	1.25
30	56	424	5.25	1.11
32	56	396	5.25	1.04
36	56	553	5.25	1.45
37	56	395	5.25	1.04
38	56	604	5.25	1.56
101	56	9036	5.25	23.7
102	57	10007	5.40	27.0
103	62	529	6.25	1.65
104	57	17856	5.40	48.2
105	57	8931	5.40	24.1
106	57	14156	5.00	35.4
107	58	18281	5.00	45.7
				215.2

---

*Only grids with significant agricultural land are included, all other grids have no significant windblown dust emissions from agricultural land.

2.6.2 Daviess County

2.6.2.1 Agricultural Tilling

County Totals

The suspended particulates generated by agricultural tilling operations in Daviess County were calculated by the method described earlier for Vanderburgh County (see Section 2.6.1.1). The percent silt in the surface soil association for this county was determined from information contained in the Daviess County soil survey[1] as follows:

1) Surface horizon silt content for each soil series in Daviess County was estimated from clay-silt-sand triangular diagram.[2] An average silt content was used for groups of minor soils or where a soil series had two different types of soil.

2) The fraction of each soil association which was comprised of the various soil series was found from the county soil survey.

3) The fraction of an association made up by each series was multiplied by the series silt content. These products were summed to obtain a weighted average silt percent of the association.

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[1] Cox, Frank R., Jr., Soil Survey of Daviess and Hancock Counties, Kentucky, United States Department of Agriculture, Soil Conservation Service and Kentucky Agricultural Experiment Station, November 1974.

[2] U.S. Department of Agriculture, Soil Survey Staff, Soil Survey Manual, Agriculture Handbook No. 18, Washington, DC, GPO, August 1951.

The soil data which was determined by this method is shown in Table 2-69.

Using the weighted average silt content for each soil association, a weighted average silt content for each grid was determined by the methods outlined in Section 2.6.1.1. The soil map used in this analysis for Daviess County is shown in Figure 2-2. The total number of acres tilled is shown in Table 2-70. The county total emissions generated by the tilling of these 520,550 acres in 1974 was 4563.0 tons.

Subcounty Apportionment

The grids with significant agricultural activity in 1974 were determined from discussions with local officials to be 400, 500, 600, 800, 900, 1000, 1100, 1200, 1300, and 1400. Emission factors were developed for each of these grids with the data described above and the methods outlined in Section 2.6.1.1. A summary of the pertinent data and emissions for each of these grids is shown in Table 2-71.

2.6.2.2 Construction Activities

County Totals

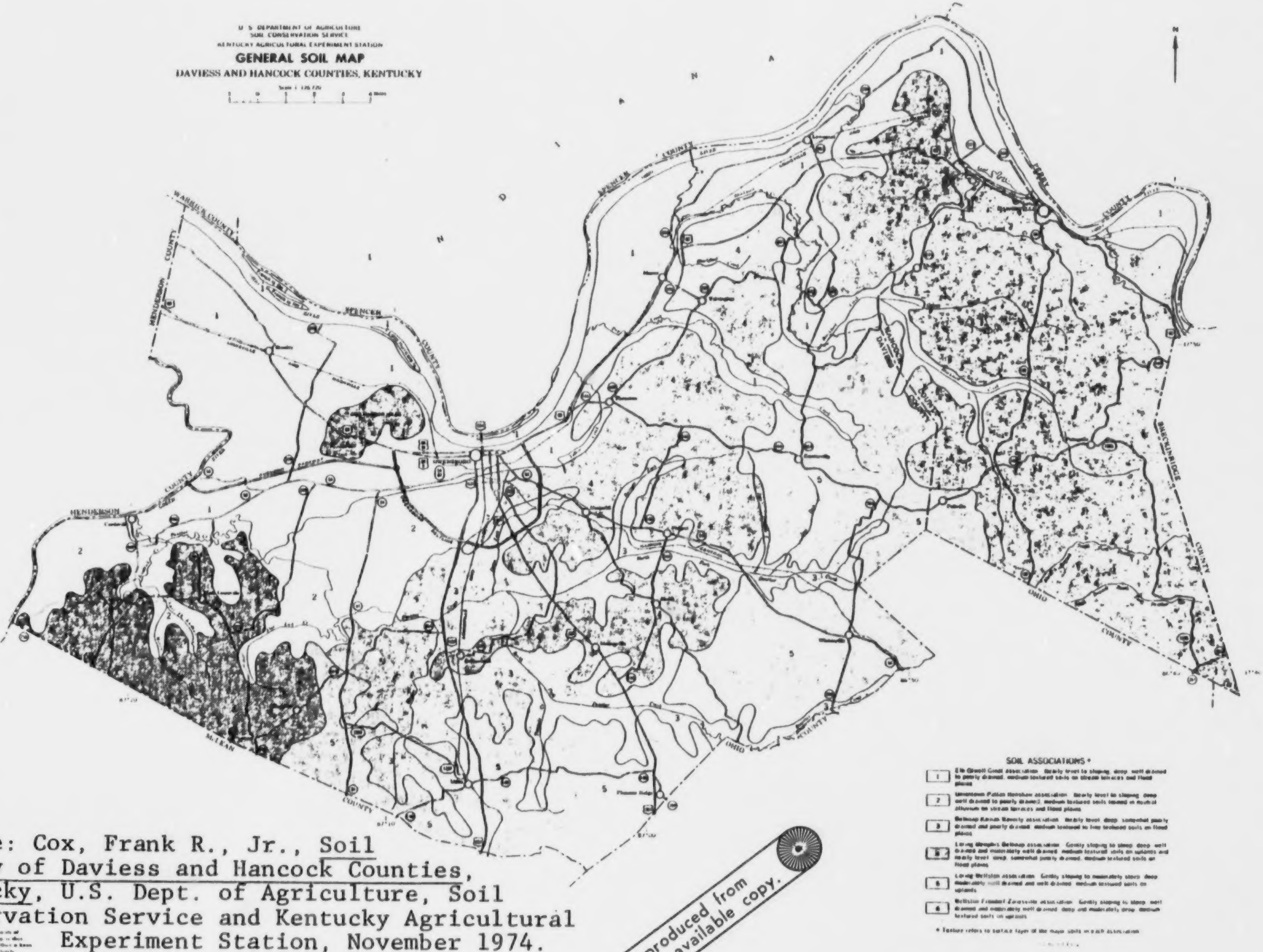
The quantity of dust generated by equipment at construction sites in Daviess County was determined on the basis of construction size, duration and location as supplied by the IAPCD. The emission factor was developed in the same manner as was outlined in Section 2.6.1.2. The value of Thornwaites precipitation-evaporation index used to adjust the emission factor was 113. The soil silt content was determined for each construction site by using an Owensboro map and the general soil map

TABLE 2-69

SILT CONTENT OF DAVIESS COUNTY SOILS

Soil Association	Component Soil Series	Fraction of Series in Association	Silt Content of Series (%)	Weighted Average Silt Content of Association (%)
1	Elk	0.17	66	60
	Otwell	0.10	66	
	Ginat	0.09	66	
	Minor Soils	0.64	56	
2	Uniontown	0.13	66	
	Patton	0.12	66	66
	Henshaw	0.11	66	
	Minor Soils	0.64	66	
3	Belknap	0.34	66	
	Karnak	0.23	56	64
	Waverly	0.20	66	
	Minor Soils	0.23	66	
4	Loring	0.35	66	
	Memphis	0.29	66	66
	Belknap	0.18	66	
	Minor Soils	0.18	66	
5	Loring	0.37	66	
	Wellston	0.23	66	66
	Minor Soils	0.40	66	
6	Wellston	0.49	66	
	Frondorf	0.20	66	64
	Zanesville	0.11	66	
	Minor Soils	0.20	58	

FIGURE 2-8


U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
KENTUCKY AGRICULTURAL EXPERIMENT STATION
GENERAL SOIL MAP
DAVIESS AND HANCOCK COUNTIES, KENTUCKY
N
INDIANA
WARRICK COUNTY
SPENCER COUNTY
PERRY COUNTY
HENDERSON COUNTY
HENDERSON
McLEAN COUNTY
OHIO COUNTY
BRECKINRIDGE COUNTY
HANCOCK
DAVIESS
SOIL ASSOCIATIONS *
1 [illegible] association. Nearly level to sloping, deep, well drained to poorly drained, medium textured soils on stream terraces and flood plains
2 Uniontown-Patton-Henshaw association. Nearly level to sloping, deep, well drained to poorly drained, medium textured soils formed in neutral alluvium on stream terraces and flood plains
3 [illegible] association. Nearly level, deep, somewhat poorly drained and poorly drained, medium textured to fine textured soils on flood plains
4 [illegible] association. Gently sloping to steep, deep, well drained and moderately well drained, medium textured soils on uplands and nearly level, deep, somewhat poorly drained, medium textured soils on flood plains
5 Loring-Wellston association. Gently sloping to moderately steep, deep, moderately well drained and well drained, medium textured soils on uplands
6 Wellston-[illegible] association. Gently sloping to steep, well drained and moderately well drained, deep and moderately deep, medium textured soils on uplands
* Texture refers to surface layer of the major soils in each association

Source: Cox, Frank R., Jr., Soil Survey of Daviess and Hancock Counties, Kentucky, U.S. Dept. of Agriculture, Soil Conservation Service and Kentucky Agricultural Experiment Station, November 1974.

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TABLE 2-70
ACRES TILLED IN 1974 - DAVIESS COUNTY

Crop	Acres Harvested[1]	No. of Tillings	Acres Tilled
Corn	46,700	3.5	163,450
Soybeans	90,600	3.5	317,100
Wheat	20,000	2.0	40,000
TOTAL	167,300		520,550

---

[1] Data supplied by Daviess County extension agent

TABLE 2-71

AGRICULTURAL TILLING EMISSIONS - DAVIESS COUNTY

Grid	Acres Tilled	Emission Factor (lb/acre)	Emissions (tons)
400	80,085	17.3	692.8
500	80,085	17.8	712.8
600	80,085	18.1	724.8
800	80,085	17.8	712.8
900	20,022	18.1	181.2
1000	80,085	17.5	700.7
1100	80,085	16.4	656.7
1200	8,899	18.1	80.5
1300	8,899	18.1	80.5
1400	2,224	18.1	20.2
TOTAL			4,563.0

(see Figure 2-8). The silt percent at each site is shown in Table 2-72. The county total emissions generated by this activity were 160 tons in 1974. Table 2-72 delineates the construction activity.

Subcounty Apportionment

Since the construction emissions were found on a project-by-project basis, no apportionment was needed. Table 2-72 shows construction activity and emissions.

2.6.2.3 Highway Vehicles - Unpaved Roads

County Totals

The suspended particulates discussed in this section were generated by vehicular traffic on unpaved roads in Daviess County in 1974. The VMT on these roads was determined for each grid by summing the lengths of unpaved roads in the grid and assuming and AADT of 15. The county total VMT determined by this method was 837,000 for 1974.

The emission factor which was used was the same as the factor previously discussed in Section 2.6.1.3 for Vanderburgh County. The parameters which were used in this emission factor for this county are as follows:

sile content(s) = 12% (assumes gravel roads)
vehicle speed = 40 mph
days with greater than 0.01 inch of rain = 118

The emission factor which was determined with these parameters is 6.4 lb/VMT. The county total particulate emissions, therefore, are determined as follows:

TABLE 2-72
CONSTRUCTION EMISSIONS - DAVIESS COUNTY

Grid	Project Type	Activity Level (acre-months)	% Silt	Emission Factor (lb/acre-mo)	TSP Emissions (tons)
701	Sewage Treatment Plant	70	60	0.47	32.9
702	Apartments	10	63.3	0.50	5.0
702	Swimming Pool	20	60	0.47	9.4
709	Apartments	10	66	0.52	5.2
709	Apartments	12	66	0.52	6.2
709	Water Treatment Plant	144	60	0.47	67.7
709	School	5	64	0.50	2.5
711	Motel	56	65.4	0.51	28.7
711	Hospital	4	60	0.47	1.9
711	County Garage	1	63.3	0.50	0.5
					160.0 tons

$$\text{Particulate Emissions} = 6.4 \text{ lb/VMT} \times 837{,}000 \text{ VMT} \times \frac{\text{ton}}{2{,}000 \text{ lb}} = 2{,}680 \text{ tons}$$

Subcounty Apportionment

The county total suspended particulates were apportioned into the grids on the basis of unpaved road VMT within each grid. A summary of the gridded VMT is shown in Table 2-73.

2.6.2.4 Highway Vehicles - Paved Roads

County Totals

The emissions reported in this section are suspended particulates caused by vehicular traffic on paved roads. The VMT was determined for each grid by the methods previously described in Section 2.3.2. Particulate emissions were calculated on the basis of an emission factor of one (1) gram per VMT. A summary of the county totals for this category is shown below:

1974 VMT = 476.4×10^6

1974 TSP Emissions = 524.6 tons

Subcounty Apportionment

The county total TSP emissions were apportioned into the grids on the basis of VMT within each grid. A summary of the paved road VMT by grid is shown in Table 2-74.

TABLE 2-73
UNPAVED ROAD VMT - DAVIESS COUNTY

Grid	VMT (10^3)
100	31.2
200	32.9
300	33.4
400	148.9
500	47.1
600	88.7
702	4.4
704	1.6
710	14.8
712	7.1
800	100.7
900	22.4
1000	127.0
1100	118.8
1200	25.8
1300	25.8
1400	6.4

TABLE 2-74
PAVED ROAD VMT - DAVIESS COUNTY

Grid	VMT (10^4)
100	586
200	586
300	586
400	2,341
500	2,341
600	2,341
701	2,304
702	2,304
703	2,304
704	2,304
705	3,055
706	3,055
707	3,055
708	3,055
709	2,304
710	2,304
711	2,304
712	2,304
800	2,341
900	586
1000	2,341
1100	2,341
1200	263
1300	263
1400	66

2.6.2.5 Aggregate Storage Piles

It was assumed for the basis of this analysis that any major emisisons from aggregate storage facilities was accounted for as a point source. The area source emisisons, therefore, are negligible.

2.6.2.6 Windblown Dust: Soil Erosion from Agricultural Fields

County Totals

The emissions which are considered in this section were produced by wind blowing across bare agricultural land. The emissions were calculated using the same methods, equations and references previously discussed in Section 2.6.1.6 for Vanderburgh County. The data used to calculate the weighted I (erodibility) for each soil association is shown in Table 2-75. The erodibility, agricultural land, emission factor and emissions which were determined by the previously discussed methods are shown in Table 2-76 for grids with significant agricultural land. All data on agricultural activity and location was supplied by the Daviess County extension agent. The county total particulate emissions resulting from this activity was determined to be 500.8 tons in 1974.

Subcounty Apportionment

Since the county total emissions were calculated on the grid level, there was no subcounty apportionment needed. The results of the grid level analysis is shown in Table 2-76.

TABLE 2-75

SOIL ERODIBILITY - DAVIESS COUNTY

Soil Association	Component Soil Series	Percent of Soil Association	Soil Series Erodibility (ton/acre-yr)	Weighted Erodibility (ton/acre-yr)
1	Elk	17	66	64
	Otwell	10	56	
	Ginat	9	56	
	Minor Soils	64	56	
2	Uniontown	13	56	60
	Patton	12	38	
	Henshaw	11	56	
	Minor Soils	64	66	
3	Belknap	34	66	62
	Karnak	23	48	
	Waverly	20	66	
	Minor Soils	23	66	
4	Loring	35	66	
	Memphis	29	66	
	Belknap	18	66	
	Minor Soils	18	66	
5	Loring	37	66	64
	Wellston	23	56	
	Minor Soils	40	66	
6	Wellston	49	56	58
	Frondorf	20	66	
	Zanesville	11	56	
	Minor Soils	20	54	

TABLE 2-76

WINDBLOWN DUST EMISSIONS - DAVIESS COUNTY

Grid	Weighted Erodibility (I) ton/acre-yr	Agricultural Land (acres)	Emission Factor (lb/acre-yr)	Particulate Emissions (tons)
400	65	24,200	6.4	77.4
500	65	24,200	6.4	77.4
600	64	24,200	6.4	77.4
800	63	24,200	6.3	76.2
900	65	6,050	6.4	19.4
1000	63	24,200	6.3	76.2
1100	64	24,200	6.4	77.4
1200	65	2,689	6.4	8.6
1300	65	2,689	6.4	8.6
1400	65	672	6.4	2.2

2.6.3 Henderson County

2.6.3.1 Agricultural Tilling

County Totals

The suspended particulates generated by agricultural tilling operations in Daviess County were calculated by the method described earlier for Vanderburgh County (see Section 2.6.1.1). The percent of silt in the surface soil for this county was determined from information contained in the Henderson County soil survey[1] by the methods previously outlined in Section 2.6.2.1 for Daviess County. Results of the soil association analysis is shown in Table 2-77. The soil map which was used to determine the weighted average silt content of the surface soil in each grid is shown in Figure 2-9.

After the soil characteristics of each grid had been determined emission factors were developed for each grid by the methods described in Section 2.6.1.1. Agricultural land areas and location were supplied by local officials. Table 2-78 shows the acres tilled by crop. The results of this analysis are as follows:

Total acres tilled = 481,000

Particulate Emissions = 4,214.0 tons

---

[1] Converse, Henry T., Jr., and Frank R. Cox, Jr., Soil Survey of Henderson County, Kentucky, United States Department of Agriculture, Soil Conservation Service and Kentucky Agricultural Experiment Station, February 1967.

TABLE 2-77

SILT CONTENT OF HENDERSON COUNTY SOILS

Soil Association	Component Soil Series	Fraction of in Association	Silt Content of Series (%)	Weighted Average Silt Content of Association (%)
1	Huntington	0.60	46	52
	Egam	0.20	61	
	Newark	0.15	66	
	Minor Soils	0.05	37	
2	Sciotoville & Wheeling	0.25	63	58
	Ginat & Melvin	0.60	66	
	Newark & Weinbach	0.05	66	
	Swampy Sloughs	0.10	0	
3	Uniontown	0.25	66	65
	Dekoven	0.22	61	
	Henshaw	0.20	66	
	Minor Soils	0.33	66	
4	Loring	0.35	66	66
	Grenada	0.20	66	
	Memphis	0.15	66	
	Uniontown	0.10	66	
	Minor Soils	0.20	65	
5	Memphis	0.60	66	66
	Wakeland	<0.40	66	
	Minor Soils	unknown	63	

(Continued)

TABLE 2-77

SILT CONTENT OF HENDERSON COUNTY SOILS (Continued)

Soil Association	Component Soil Series	Fraction of in Association	Silt Content of Series (%)	Weighted Average Silt Content of Association (%)
6	Loring	0.36	66	66
	Zanesville	0.12	66	
	Wellston	0.08	66	
	Minor Soils	0.44	66	
7	Markland	0.30	66	61
	Sharkey	0.25	46	
	Newark	0.18	66	
	Minor Soils	0.27	66	

FIGURE 2-9

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
KENTUCKY AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
HENDERSON COUNTY, KENTUCKY

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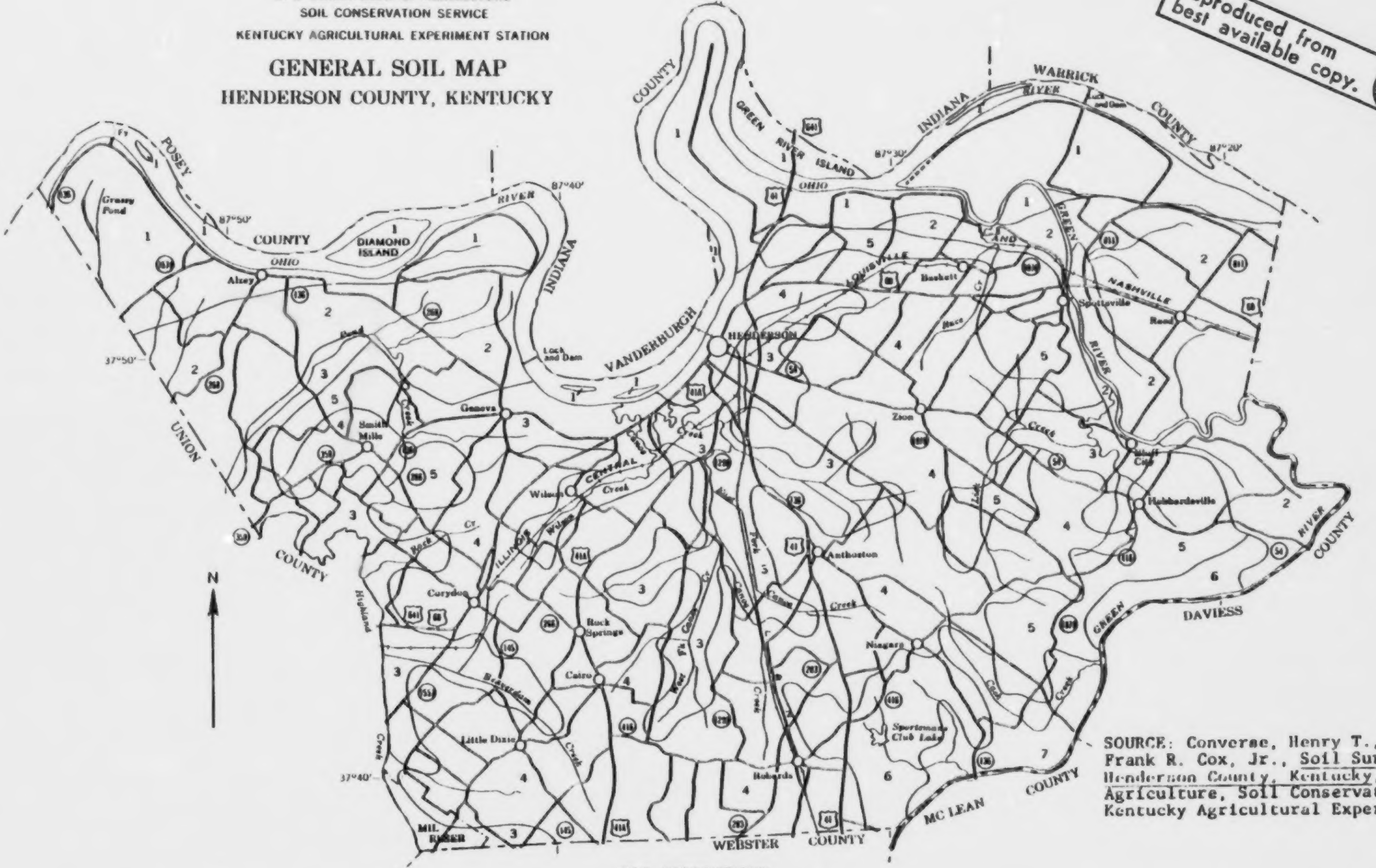
POSEY COUNTY
INDIANA
VANDERBURGH COUNTY
WARRICK COUNTY
UNION COUNTY
WEBSTER COUNTY
MC LEAN COUNTY
DAVIESS COUNTY
OHIO RIVER
GREEN RIVER
GREEN RIVER ISLAND
DIAMOND ISLAND
Grassy Pond
Alzey
Geneva
Smith Mills
Wilson
Corydon
Rock Springs
Cairo
Little Dixie
HENDERSON
Anthoston
Niagara
Robards
Zion
Baskett
Spottsville
Reed
Hebbardsville
Sportsmans Club Lake
Lock and Dam
LOUISVILLE AND NASHVILLE
Highland Creek
Canoe Creek
Cypress Creek
87°50'
87°40'
87°30'
87°20'
37°50'
37°40'
N

SOURCE: Converse, Henry T., Jr., and Frank R. Cox, Jr., Soil Survey of Henderson County, Kentucky, U.S. Dept. of Agriculture, Soil Conservation Service and Kentucky Agricultural Experiment Station, Feb. 1967.

SOIL ASSOCIATIONS

1	Huntington-Egam-Newark association: Brown, nearly level, dominantly well-drained, silty soils on the flood plain of the Ohio River
2	Ginat-Melvin association: Brown or gray, nearly level or gently sloping, dominantly poorly drained, silty soils on the flood plain of the Ohio River
3	Uniontown-Dekoven-Henshaw association: Very dark grayish brown to brown, level or nearly leve , very poorly drained to well drained, silty soils on terraces and bottom lands along creeks
4	Loring-Grenada association: Brown, nearly level to strongly sloping, well drained and moderately well drained soils of the loess uplands
5	Memphis-Wakeland association: Brown, strongly sloping to steep, dominantly well-drained, silty soils on bluffs, terraces, and bottom lands
6	Loring-Zanesville-Wellston association: Brown, mostly gently sloping to strongly sloping, well drained and moderately well drained soils that developed primarily from loess or from loess over sandstone
7	Markland-Sharkey-Newark association: Brown or very dark gray, level, well-drained to very poorly drained, clayey or silty soils on terraces and bottom lands of the Green River

Scale 1:190 080

1 0 1 2 3 4 Miles

October 1965

TABLE 2-78
ACRES TILLED IN 1974 - HENDERSON COUNTY

Crop	Acres Harvested	Number of Tillings	Acres Tilled
Corn	58,500	3.5	204,750
Soybeans	71,500	3.5	250,250
Wheat	13,000	2	26,000
TOTAL	143,000		481,000

Subcounty Apportionment

The particulate emissions, as was discussed previously, were calculated on the grid level. The apportioning into grids occurred in the determination of agricultural land location. This determination was made as follows:

1) It was assumed that there was no significant agricultural activity within the Henderson city limits.

2) The agricultural land was apportioned into the grids outside the Henderson city limits by assuming that agricultural activity was directly proportional to land area and inversly proportional to population density.

A summary of the agricultural land acres, emission factors and emissions for each grid with agricultural activity is shown in Table 2-79.

2.6.3.2 Construction Activities

County Totals

The quantity of dust generated by equipment at construction sites in Henderson County was determined on the basis of construction size, duration and location as supplied by

TABLE 2-79
AGRICULTURAL TILLING EMISSIONS - HENDERSON COUNTY

Grid	Acres Tilled	Emission Factor (lb/acre)	Particulate Emissions (tons)
206N	962	17.8	8.6
206S	962	17.8	8.6
207N	72,631	17.0	617.4
207S	72,631	17.5	635.5
208	199,134	17.8	1772.3
209N	67,340	16.7	592.3
209S	67,340	18.1	609.4

the IAPCD. The emission factor was developed in the same manner as was outlined in Section 2.6.1.2. The value of Thornwaites precipitation evaporation index used to adjust the emission factor was 113. The soil silt content was determined for each construction site by using a Henderson map and the general soil map (see Figure 2-3). The silt percent at each site is shown in Table 2-72. The county total emissions generated by this activity was 1.98 tons in 1974. Table 2-80 delineates the construction activity.

Subcounty Apportionment

Since the construction emissions were found on a project-by-project basis, no apportionment was needed. Table 2-80 shows construction activity and emissions.

2.6.3.3 Highway Vehicles - Unpaved Roads

County Totals

The suspended particulates discussed in this section were generated by vehicular traffic on gravel and dirt roads in Henderson County in 1974. The VMT on these roads was determined for each grid by summing the lengths of unpaved roads in the grid and assuming an AADT of 15. The VMT were divided between gravel and dirt roads on the basis of a county average of 95% gravel and 5% dirt as determined from road surface data supplied by the IAPCD.

Emission factors were developed for each grid by the methods described in Section 2.6.1.3. Table 2-81 summarizes

TABLE 2-80
HENDERSON COUNTY CONSTRUCTION ACTIVITY

Grid	Activity Level (acre-month)	% Silt	Emission Factor (ton/acre-mo)	Particulate Emissions (tons)
206N	2.89	66	0.52	1.50
206N	0.17	66	0.52	0.09
206N	0.12	66	0.52	0.33

TABLE 2-81

UNPAVED ROAD EMISSIONS - HENDERSON COUNTY

	VMT x 10^3		% Silt		Emission Factor (lb/vmt)		TSP Emissions (tons)		
Grid	Gravel	Dirt	Gravel	Dirt	Gravel	Dirt	Gravel	Dirt	TOTAL
207N	271.7	14.3	12	56	6.4	29.8	869	213	1,182
207S	235.2	12.4	12	64	6.4	34.1	753	211	964
208	261.7	13.8	12	65	6.4	34.6	837	239	1,176
209N	86.1	4.5	12	62	6.4	33.0	275	74	349
209S	334.6	17.6	12	66	6.4	35.1	1,071	309	1,380

the parameters used in determining this factor. The county total VMT and TSP emissions are as follows:

	VMT	EMISSIONS
gravel roads:	1189×10^3	3805 tons
dirt roads:	63×10^3	1046 tons
TOTAL	1252×10^3	4450 tons

Subcounty Apportionment

As was discussed previously, unpaved road data was developed for each grid. Apportionment, therefore, was not needed. Table 2-81 summarizes this grid data.

2.6.3.4 Highway Vehicles - Paved Roads

County Totals

The emissions reported in this section are suspended particulates caused by vehicular traffic on paved roads. The VMT was determined for each grid by the methods previously described in Section 2.3.3. Particulate emissions were calculated on the basis of an emission factor of one (1) gram per VMT. A summary of the county totals for this category is shown below:

1974 VMT = 313.5×10^6

1974 TSP Emissions = 345.3 tons

Subcounty Apportionment

The county total TSP emissions were apportioned into the grids on the basis of VMT within each grid. A summary of the paved road VMT by grid is shown in Table 2-82.

2.6.3.5 Aggregate Storage Piles

It was assumed for the basis of this analysis that any major emissions from aggregate storage facilities was accounted for as a point source. The area source emissions, therefore, are negligible.

2.6.3.6 Windblown Dust: Soil Erosion from Agricultural Fields

County Totals

The emissions which are considered in this section were produced by wind blowing across bare agricultural land. The emissions were calculated using the same methods, equations and references previously discussed in Section 2.6.1.6 for Vanderburgh County. The data used to calculate the weighted I (erodibility) for each soil association is shown in Table 2-83. The erodibility, agricultural land, emission factor and emissions which were determined by the previously discussed methods are shown in Table 2-84 for grids with significant agricultural land. All data on agricultural activity and location was supplied by the Henderson County extension agent. The county total emissions generated by this source was 389.3 tons in 1974.

Subcounty Apportionment

Since the county total emissions were calculated on the grid level, there was no subcounty apportionment needed. The results of the grid level analysis is shown in Table 2-84.

TABLE 2-82
PAVED ROAD VMT - HENDERSON COUNTY

Grid	VMT (10^6)
201	16.9
202	19.7
203	11.3
204	15.5
205	21.2
206N	31.0
206S	25.4
207N	45.3
207S	26.1
208	48.6
209N	27.8
209S	26.1

TABLE 2-83

SOIL ERODIBILITY - HENDERSON COUNTY

Soil Association	Component Soil Series	Percent of Soil Association	Soil Series Erodibility (ton/acre-yr)	Weighted Erodibility (ton/acre-yr)
1	Huntington	60	56	54.1
	Egam	20	56	
	Newark	15	56	
	Minor Soils	5	18	
2	Sciotoville, Wheeling	25	56	56
	Ginat, Melvin	60	56	
	Newark, Weinbach	5	56	
	Swampy Sloughs	10	0	
3	Uniontown	25	56	56
	Dekoven	22	56	
	Henshaw	20	56	
	Minor Soils	33	56	
4	Loring	35	56	56
	Grenada	20	56	
	Memphis	15	56	
	Uniontown	10	56	
	Minor Soils	20	56	
5	Memphis	60	56	56
	Wakeland	<40	56	
	Minor Soils	unknown	56	

(Continued)

TABLE 2-83

SOIL ERODIBILITY - HENDERSON COUNTY (Continued)

Soil Association	Component Soil Series	Percent of Soil Association	Soil Series Erodibility (ton/acre-yr)	Weighted Erodibility (ton/acre-yr)
6	Loring	36	56	56
	Zanesville	12	56	
	Wellston	8	56	
	Minor Soils	44	56	
7	Markland	30	56	49
	Sharkey	25	28	
	Newark	18	56	
	Minor Soils	27	56	

TABLE 2-84
WINDBLOWN DUST EMISSIONS - HENDERSON COUNTY

Grid	Weighted Erodibility (I) ton/acre-yr	Agricultural Land (acres)	Emission Factor (lb/acre-yr)	Particulate Emissions (tons)
206N	56	286	5.5	0.8
206S	56	286	5.5	0.8
207N	55	21,593	5.4	58.3
207S	56	21,593	5.5	59.4
208	55	59,202	5.4	159.8
209N	56	20,020	5.5	55.1
209S	56	20,020	5.5	55.1

2.7 Miscellaneous Area Sources

2.7.1 Vanderburgh County

2.7.1.1 Process Losses

The emissions which are considered here are emissions from industrial and commercial/institutional processes for which specific emissions and location data are available but which are too small to be a point source. The Evansville EPA determined that no significant process loss sources are area sources.

2.7.1.2 Structural Fires

County Totals

The data for the determination of structural fire emissions was supplied by the Evansville Fire Department. This data indicated that there were 393 structural fires in 1974. The quantity of wood burned in these fires was determined on the basis of 16.8 tons burned per fire. Emissions were calculated on the basis of EPA emission factors and are shown in Table 2-85.

TABLE 2-85
STRUCTURAL FIRES EMISSIONS - VANDERBURGH COUNTY

	Emission Factor (lb/ton)		Emissions (TPY)	
Tons Burned	Particulate	SO_2	Particulate	SO_2
6,602	17	neg	56.1	neg

Subcounty Apportionment

The 1974 county total emissions were allocated into the grids on the basis of 1974 population.

2.7.1.3 Forest Fires

Information provided by the Indiana Department of Natural Resources, Division of Forestry indicates that there were no significant forest, grass or brush fires in Vanderburgh County in 1974. The area source emissions, therefore, were assumed to be negligible.

2.7.2 Daviess County

2.7.2.1 Process Losses

County Totals

The particulate and SO_2 emissions generated by small non-point source processes in Daviess County were determined from information supplied by the local air pollution agency. This data consisted of process description, location and emission estimates. The county total emissions generated by these sources is shown below:

1974 particulate emissions = 48.8 tons

1974 SO_2 emissions = 44.1 tons

Subcounty Apportionment

The data which was available for these sources indicated that these sources were primarily small industrial sources within Owensboro. The county total emissions, therefore, were apportioned into the grids within Owensboro on the basis of industrial employment.

2.7.2.2 Structural Fires

County Totals

The data for the determination of structural fire emissions was supplied by the Owensboro Fire Department and the Daviess County Fire Department. This data indicated the following number of structural fires which occurred in 1974:

Within Owensboro:	261
Remainder of Daviess County:	91
TOTAL	352

The quantity of material burned in these fires was determined on the basis of 16.8 tons/unit. Emissions were calculated on the basis of EPA emission factors. A summary of this analysis is shown in Table 2-86.

TABLE 2-86

DAVIESS COUNTY STRUCTURAL FIRES EMISSIONS

Area	Tons Burned	Emission Factor (lb/ton) Particulate	Emission Factor (lb/ton) SO_2	Emissions (tons) Particulate	Emissions (tons) SO_2
Owensboro	4385	17	Neg.	37.3	Neg.
Remainder of Daviess County	1529	17	Neg.	13.0	Neg.
TOTAL	5914			50.3	Neg.

Subcounty Apportionment

The emissions generated by the fires in Owensboro were apportioned into grids 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711 and 712 on the basis of population. The emissions in the remainder of the county were apportioned into the remaining grids on the basis of population.

2.7.2.3 Forest Fires

County Totals

The number of forest fires in Daviess County in 1974 was provided by officials of the Green River Forestry District. This data indicated that there were a total of five fires which burned a total of over seven acres. Based on a loading of nine tons consumed per acre burned, there were 63 tons burned. The emission factors used and the emissions calculated are as follows:

	Particulate	SO_2
Emission factor	17 lb/ton	Neg.
Emissions	0.5 tons	Neg.

Subcounty Apportionment

Due to the small quantity of emissions and their temporary, localized affect, the apportioned emissions were assumed to be negligible.

2.7.3 Henderson County

2.7.3.1 Process Losses

County Totals

The quantity of particulate and SO_2 emissions generated by these sources was determined from process and emissions data supplied by IAPCD. A summary of the emissions determined from this data is as follows:

1974 Particulate Emissions = 37.6 tons

1974 SO_2 Emissions = 0

Subcounty Apportionment

The county total emissions were apportioned into the grids on the basis of manufacturing employment.

2.7.3.2 Structural Fires

County Totals

Data supplied by the IAPCD indicated that there were 115 structural fires in Henderson County in 1974. The quantity of material burned was determined by using a factor of 16.8 tons burned per fire. Emissions were calculated with EPA emission factors. A summary of this data is shown below:

Tons burned:	1932
Particulate Emission Factor:	17 lb/ton
SO_2 Emission Factor:	Negligible
Particulate Emissions:	16.4 tons
SO_2 Emissions:	Negligible

Subcounty Apportionment

The county total particulate emissions were apportioned into the grids on the basis of 1974 population.

2.7.3.3 Forest Fires

County Totals

The number of forest fires in Henderson County in 1974 was provided by officials of the Green River Forestry District. This data indicated that there was one fire which burned a total of one acre. Based on a loading of nine tons consumed per acre burned, there were nine tons burned. The emission factors used and the emissions calculated are as follows:

	Particulate	SO_2
Emission Factors	17 lb/ton	Neg.
Emissions	0.08 tons	Neg.

Subcounty Apportionment

Due to the small quantity of emissions and their temporary localized affect, the apportioned emissions were assumed to be negligible.

3.0 PROJECTED AREA SOURCE EMISSIONS

3.1 Introduction

This chapter presents estimates of future year particulate and sulfur dioxide emissions for the area source categories inventoried in Chapter 2. The order of categories and counties is the same as in Chapter 2.

The methodologies employed to project emissions are based on published planning data from the appropriate local and regional planning agencies. For each category and pollutant, an emission growth factor (EGF) is defined. The EGF, when multiplied times the base year emissions, yields projected emissions. In most cases the EGF is a county-wide number which also has been applied to zonal emissions. Zone specific growth factors have been used only in selected categories.

3.2 Fuels-Stationary Sources

3.2.1 Vanderburgh County

3.2.1.1 Residential Fuels

Projection of residential heating emissions should account for population growth and significant heating fuel shifts. In the context of this study, no significant fuel shifts are predicted for Evansville over the planning period. Population increases for 1975, 1980, and 1985 have been interpolated based on the 2000 EUTS plan. Interpolation was performed for each traffic zone and each projection year between 1974 and the year 2000 projection. The county projections for 1975, 1980, and 1985 shown below were obtained by aggregating the zonal projections.

are shown below. Refer to Section 2.1 for a description of how the base population was estimated.

Vanderburgh County Population Projections

1974	173,464	(1.0 - base)
1975	174,553*	(1.006)
1980	182,668*	(1.053)
1985	184,456*	(1.063)
2000	201,818	(1.163)

---

* Linear interpolation

Due to the relatively small county growth rate over the AQMA planning period (6.3%) the zone level projected emissions have been computed using the county growth rate. These results are summarized below for the county.

Vanderburgh County Projected Residential Fuel Emissions (Tons)

1975			1980			1985		
EGF	TSP	SO_2	EGF	TSP	SO_2	EGF	TSP	SO_2
1.006	123.5	494.3	1.053	129.3	517.4	1.063	130.5	522.4

3.2.1.2 Commercial/Institutional Fuels

Projection of emissions from commercial/institutional heating fuels has been made based on county population. Derivation of the population growth factors was described in Section 3.2.1.1. The resulting projected county emissions are shown below. The county growth factor was also applied to emisisons at the grid level.

Vanderburgh County Projected Commercial/Institutional Fuel Emissions (Tons)

1975			1980			1985		
EGF	TSP	SO_2	EGF	TSP	SO_2	EGF	TSP	SO_2
1.006	56.4	301.9	1.053	59.1	316.0	1.063	59.6	319.0

3.2.1.3 Industrial Fuels

Industrial area source fuel emissions have been projected based on estimated total employment growth in Vanderburgh County. The projections of employment available were for the entire EUTS region, larger than Vanderburgh County.

The EUTS regional employment statistics are shown below.[1] 1974, 1975, 1980, and 1985 employment have been interpolated for purposes of computing growth factors.

EUTS Regional

Year	Employment	Regional GF
1970	75,757[1]	
1974	82,378*	1.0
1975	84,034*	1.020
1980	92,311*	1.12
1985	100,465*	1.22
2000	125,174[1]	

* Linear interpolation

---

[1] Evansville Urban Transportation Study, Annual Report, July 1, 1975.

Since these growth estimates are probably high for Vanderburgh County, the relative population growth rates for the EUTS region and Vanderburgh County have been used to estimate Vanderburgh County employment. These population statistics are shown below.

	EUTS Region		Vanderburgh County	
Year	Population	GF	Population	GF
1970	172,070[1]			
1974	184,314*	1.0	173,464[1]	1.0
1975	186,280*	1.011	174,553*	1.006
1980	196,108*	1.064	182,668*	1.053
1985	205,936*	1.117	184,456*	1.063
2000	235,420[2]	1.277	201,818[1]	1.163

* Linear Interpolation

The above region and county growth factors were used to scale the regional employment forecasts. The resulting county employment estimates are shown below.

Year	County Employment Growth Factor
1974	1.000
1975	1.02 x 1.006/1.011 = 1.015
1980	1.12 x 1.053/1.064 = 1.109
1985	1.22 x 1.063/1.117 = 1.161

---

[1] Personal Communication, data supplied by EUTS, August, 1976.

[2] Evansville Urban Transportation Study, Annual Report, July 1, 1975.

The above computed county factors have been used to project industrial fuel emissions. The results are shown below.

Vanderburgh County Projected
Industrial Fuel Emissions
(Tons)

1975			1980			1985		
EGF	TSP	SO_2	EGF	TSP	SO_2	EGF	TSP	SO_2
1.015	2718	2965	1.109	2969	3239	1.161	3108	3391

The above emission growth factors were also applied to emissions at the zone level.

3.2.2 Daviess County

3.2.2.1 Residential Fuels

Projection of residential heating fuel emissions has been performed using population growth estimates. Overall county population growth for 1980 and 1985 was obtained from OBERS, Series E[1]. The county projections are shown below. Population for 1974 and 1975 were computed by interpolation between 1971 and 1980.

DAVIESS COUNTY POPULATION PROJECTIONS

Year	Population	GF
1971	78,898	
1974	84,300	1.000
1975	86,100	1.021
1980	95,100	1.128
1985	100,000	1.186

The county population growth factors were applied to base year county and grid emissions. The county projected emissions are shown below.

DAVIESS COUNTY PROJECTED RESIDENTIAL FUEL EMISSIONS (tons)

	1975			1980			1985	
EGF	TSP	SO_2	EGF	TSP	SO_2	EGF	TSP	SO_2
1.021	1,310	8,131	1.128	1,447	8,983	1.186	1,521	9,445

---

[1] U.S. Dept. of Commerce, Social and Economic Statistics Admin., Regional Economic Analysis Div., 1972 OBERS projections.

3.2.2.2 Commercial/Institutional Fuels

The population projections obtained above were also used to project commercial/institutional fuel emissions for Daviess County. These results are shown below.

DAVIESS COUNTY
PROJECTED COMMERCIAL/INSTITUTIONAL FUEL EMISSIONS (tons)

1975			1980			1985		
EGF	TSP	SO_2	EGF	TSP	SO_2	EGF	TSP	SO_2
1.021	1,357	3,191	1.128	1,499	3,525	1.186	1,576	3,706

The county growth factors for each projection year was also applied to base year gridded emissions.

3.2.2.3 Industrial Fuels

Projection of industrial area source fuel emissions was based on industrial employment 1972 and 1995 planning data from the Owensboro Urban Area Transportation Study. Interpolations for 1974, 1975, 1980, and 1985 was performed to obtain the growth factors shown below.

Year	Owensboro Industrial Employment	Growth Factor
1972	9,367	
1974	9,839	1.000
1975	10,075	1.024
1980	11,254	1.144
1985	12,433	1.264
1995	14,792	

The above growth factors were applied to county and grid level emissions to obtain projected emissions. The county projected emissions are shown below.

DAVIESS COUNTY
PROJECTED INDUSTRIAL FUEL EMISSIONS (tons)

	1975			1980			1985	
EGF	TSP	SO_2	EGF	TSP	SO_2	EGF	TSP	SO_2
1.024	34.2	263	1.144	38.2	294	1.264	42.2	325

3.2.3 Henderson County

3.2.3.1 Residential Fuels

Residential fuel emissions have been projected using population projections. Projections were calculated for each 1970 census tract in the Henderson urban area (Census Tracts 201, 202, 203, 204, 205, and 206) using Henderson Urban Transportation Study traffic zone data for 1971, 1980, and 1995. For each urban area census tract, growth factors were computed by aggregating the traffic zone population for 1971, 1980, 1995 and then interpolating to obtain 1974, 1975, 1980, and 1985 population. These projections were then used to scale up 1970 census data.

For the non-urban area, census tracts 207, 208, and 209, Evansville SMSA OBERS projections for 1980 and 1985 were used. The county projections using the above methods applied to 1970 census data is shown below.

HENDERSON COUNTY
POPULATION PROJECTIONS

(Census)	1970	36,033	
(Study base)	1974	38,083	(1.000)
	1975	38,593	(1.013)
	1980	41,188	(1.082)
	1985	43,490	(1.142)

The above county growth factors were applied to 1974 county and grid emissions. The county emissions are shown below.

HENDERSON COUNTY
PROJECTED RESIDENTIAL FUEL EMISSIONS (tons)

1975			1980			1985		
EGF	TSP	SO_2	EGF	TSP	SO_2	EGF	TSP	SO_2
1.013	19.8	28.6	1.082	21.1	30.5	1.142	22.3	32.2

3.2.3.2 Commercial/Institutional Fuels

Emissions were projected for this category based on the population growth factors described for residential fuels. The county growth factors were applied to county emissions and the gridded emissions. The county projected emissions are summarized below.

HENDERSON COUNTY
PROJECTED COMMERCIAL/INSTITUTIONAL FUEL EMISSIONS (tons)

	1975			1980			1985	
EGF	TSP	SO_2	EGF	TSP	SO_2	EGF	TSP	SO_2
1.013	6.4	29.2	1.082	6.8	31.2	1.142	25.5	36.8

3.2.3.3 Industrial Fuels

Industrial area source fuel emissions have been projected using 1971, 1980, 1995 industrial employment data from the Henderson Urban Transportation Study. Growth factors have been developed by interpolation. The resulting growth factors are shown below.

HENDERSON URBAN TRANSPORTATION STUDY EMPLOYMENT PROJECTIONS

1971	3,553	
1974	3,738*	(1.000)
1975	3,799*	(1.016)
1980	4,107	(1.099)
1985	4,401*	(1.177)
1995	4,988	

---

*Interpolation

The above factors were used to project county and grid emissions. The county emissions are shown below.

HENDERSON COUNTY

PROJECTED INDUSTRIAL FUEL EMISSIONS (tons)

1975			1980			1985		
EGF	TSP	SO_2	EGF	TSP	SO_2	EGF	TSP	SO_2
1.016	12.1	93.2	1.099	13.1	100.8	1.177	14.0	107.9

3.3 Highway Vehicles

Projection of highway vehicle exhaust and tire wear emissions took into account two factors: (1) decrease in automotive emission factors due to the FMVCP and (2) changes in vehicle-miles traveled in each county. The current projected emission factors are shown below.

PROJECTED HIGHWAY VEHICLE
EMISSION FACTORS[1]

Year	TSP EF	GF	SO_2 EF	GF
1974	0.61 g/mi	(1.000)	0.23 g/mi	(1.000)
1975	0.59	(0.967)	0.23	(1.000)
1980	0.47	(0.770)	0.20	(0.870)
1985	0.41	(0.672)	0.19	(0.826)

The following sections describe the projected VMT and emissions for each county.

3.3.1 Vanderburgh County

Projections of vehicle miles traveled were provided by EUTS. A projected daily VMT was available for each traffic zone in the base year inventory (see Section 2.3.1) except Union Township. For this rural township, the VMT growth rate for the traffic zones in Perry Township (Census tract 104) was used. Since the base year VMT data was assumed representative of both 1974 and 1975, only 1980 and 1985 VMT projections were required.

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[1] Environmental Protection Agency, Compilation of air pollutant emission factors, 2nd ed, with supplements. AP-42. Research Triangle Park, N.C., Feb. 1972, April 1973, July 1973, Sept. 1973, July 1974, Jan. 1975, Dec. 1975, Feb. 1976.

The first step was to aggregate the projected 1995 traffic zone VMT into the 46 Census tract grids. These totals for 1995 are shown in Table 3-1. The projected VMT for 1980 and 1985 for each grid was then calculated by linear interpolation between 1975 and 1995. These projections are also shown in Table 3-1.

Projected emissions were calculated for each census tract. The projected county emissions are shown below.

Vanderburgh County Projected Highway Vehicle Emissions

Year	TSP EGF	TSP Emissions
1975	0.967 x 1.000 = 0.967	643 tons
1980	0.770 x 1.032 = 0.795	529
1985	0.672 x 1.065 = 0.716	476
	SO_2 EGF	
1975	1.000 x 1.000 = 1.000	255 tons
1980	0.870 x 1.032 = 0.898	252
1985	0.826 x 1.065 = 0.880	224

3.3.2 Daviess County

Highway travel projections for Owensboro obtained from the 1995 Plan as analyzed by the SAPOLUT model.[1]

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[1] Merchant, Richard D., Private Communication, Indiana Board of Health, Air Pollution Control Division, 1 November, 1976.

TABLE 3-1

PROJECTED VMT BY GRID VANDERBURGH COUNTY

Census Tract Grid	Annual VMT (10^6)			
	1974-1975	1980**	1985**	1995*
1	22.1	21.6	21.1	20.1
2	32.2	33.9	35.6	38.9
3	19.5	18.2	16.8	14.2
4	11.0	12.8	14.5	18.0
5	5.5	5.8	6.2	6.9
6	5.2	5.0	4.7	4.1
7	18.3	19.1	19.8	21.4
8	16.8	15.1	13.3	9.9
9	24.1	21.2	18.3	12.5
10	18.0	18.2	18.3	18.5
11	13.3	13.5	13.7	14.0
12	2.9	2.9	3.0	3.2
13	2.2	2.4	2.5	2.9
14	5.8	4.9	4.0	2.1
15	6.2	5.6	4.9	3.7
16	1.4	4.7	7.9	14.4
17	1.3	4.4	7.5	13.6
18	9.4	19.9	30.4	51.4
19	8.3	7.9	7.5	6.7
20	6.0	5.6	5.1	4.3
21	9.2	8.6	8.1	6.9
22	133.9	108.	82.1	30.3
23	9.4	9.5	9.6	9.7
24	19.5	18.1	16.8	14.1
25	6.4	6.0	5.7	4.9
26	7.7	7.3	6.9	6.1
27	72.6	56.2	39.8	7.0
28	39.8	36.2	32.6	25.4

(Continued)

TABLE 3-1
PROJECTED VMT BY GRID - VANDERBURGH COUNTY (Continued)

Census Tract Grid	Annual VMT (10^6) 1974-1975	1980**	1985**	1995*
29	2.4	3.7	5.0	7.6
30	11.4	12.5	13.7	15.9
31	9.0	9.3	9.6	10.2
32	9.3	11.5	13.8	18.2
33	41.1	32.3	33.4	25.8
34	38.8	35.7	32.6	26.4
35	11.9	14.7	17.5	23.2
36	7.0	6.4	5.8	4.6
37	48.5	47.7	47.0	45.4
38	17.8	19.6	21.5	25.1
39	6.2	6.0	5.8	5.5
101	35.1	52.8	70.5	106.
102	151.4	155.6	159.7	168.
103	9.2	15.8	22.4	35.7
104	29.9	38.7	47.6	65.2
105	18.8	25.6	34.2	46.0
106	3.6	5.8	8.0	12.4
107	23.5	44.3	65.0	106.5
County Totals	1,003	1,036	1,068	1,133
Growth Factors	(1.000)	(1.032)	(1.065)	(1.130)

* Compiled from EUTS Recommended Plan Traffic Zone Projections

** Interpolation

The VMT growth factors below were calculated by interpolating between 1972 and 1995 daily vehicle miles for the CBD, central city, and suburban area. These results are shown below.

Owenboro Projected Daily VMT

1972	783,103	
1974	839,837*	(1.000)
1975	868,255*	(1.034)
1980	1,010,166*	(1.203)
1985	1,152,078*	(1.372)
1995	1,435,900	

---

*Interpolation

The projected VMT and emission factors were applied to conuty and zonal base year emissions. The county level results are shown below.

Daviess County Projected Highway Vehicle Emissions

Year	TSP EGF	TSP Emissions
1975	0.967 x 1.034 = 1.000	315 tons
1980	0.880 x 1.203 = 0.926	292
1985	0.672 x 1.372 = 0.922	291
	SO_2 EGF	SO_2 Emissions
1975	1.000 x 1.034 = 1.034	125 tons
1980	0.870 x 1.203 = 1.047	126
1985	0.826 x 1.372 = 1.133	137

3.3.3 Henderson County

Highway travel projections were available for the Henderson city urban area. Interpolation between 1970 and 1995 was used to establish the required VMT. The results are shown below.

Henderson Highway Travel Projections (daily VMT)

1970	335,774	
1974*	384,591	(1.000)
1975*	196,795	(1.032)
1980*	457,816	(1.190)
1985*	518,874	(1.349)
1995	640,880	

---

*Interpolation

The projected VMT and emission factors were applied to county and zonal base year emissions. The county level results are shown below.

Henderson County Projected Highway Vehicle Emissions

Year	TSP EGF	TSP Emissions
1975	0.967 x 1.032 = 0.998	208 tons
1980	0.770 x 1.190 = 0.916	191
1985	0.672 x 1.349 = 0.907	189
	SO_2 EGF	SO_2 Emissions
1975	1.000 x 1.032 = 1.032	82 tons
1980	0.870 x 1.190 = 1.035	83
1985	0.826 x 1.349 = 1.114	89

3.4 Fuels - Off Highway Vehicles

A limited amount of information was available regarding projections of activity for the six subcategories inventoried in Chapter 2.0. Base year emissions from these subcategories is shown below.

Summary of Off Highway Vehicle Emissions (tons)

	Vanderburgh		Daviess		Henderson	
Subcategory	TSP	SO_2	TSP	SO_2	TSP	SO_2
Railroad Engines	42.5	97.0	23.5	53.6	10.8	24.5
Vessels	10.9	63.0	7.9	48.2	32.9	189.3
Aircraft	22.5	19.9	9.5	3.7	1.2	0.6
Farm Tractors	10.7	7.3	21.4	14.5	27.2	18.6
Construct. Equip.	36.1	37.1	28.7	29.6	3.5	3.6
Miscellaneous	33.6	25.0	16.0	11.9	7.4	5.5

No significant change is expected in the level of emissions from these sources during the 10 year AQMA planning period.

3.5 Solid Waste Disposal

3.5.1 Vanderburgh County

3.5.1.1 Incineration

Projection of emissions from incineration have been made for residential, commercial/institutional, and industrial subcategories. The population and employment growth factors developed in Section 3.2 have been used to project incineration emissions. The county projections are summarized below.

Vanderburgh County Projected Incineration Emissions (tons)

	1975			1980			1985		
	EGF	TSP	SO_2	EGF	TSP	SO_2	EGF	TSP	SO_2
Residential	1.006	20.6	3.2	1.053	21.6	3.4	1.063	21.8	3.4
Com/Instit.	1.006	13.7	4.3	1.053	14.3	4.5	1.063	14.5	4.6
Industrial	1.015	8.2	2.5	1.109	9.0	2.8	1.161	9.4	2.9

The county growth factors were also applied to emissions at the zone level.

3.5.1.2 Open Burning

Projection of open burning emissions have been made for three subcategories: residential, commercial/institutional, and industrial. The growth factors developed in Section 3.2 were used to project emissions for each subcategory. They are the same as used for incineration. The county projected emissions are shown below.

Vanderburgh County Projected Open Burning Emissions (tons)

	1975			1980			1985		
	EGF	TSP	SO_2	EGF	TSP	SO_2	EGF	TSP	SO_2
Residential	1.006	10.4	0.6	1.053	10.8	0.6	1.063	10.9	0.6
Com./Instit.	1.006	1.1	---	1.053	1.2	---	1.063	1.2	---
Industrial	1.015	2.1	0.1	1.109	2.3	0.1	1.161	2.4	0.2

The county growth factors were also applied to emissions at the zone level.

3.5.2 Daviess County

3.5.2.1 Incineration

Projections of incineration emissions have been made for residential, commercial/institutional, and industrial subcategories. Residential and C/I emissions have been projected based on the population growth factors developed in Section 3.2.2.1. Industrial incineration has been projected using industrial employment growth factors developed in Section 3.2.2.3. The county projected emisisons are shown below.

Daviess County Projected Incineration Emissions (tons)

		1975			1980			1985	
	EGF	TSP	SO_2	EGF	TSP	SO_2	EGF	TSP	SO_2
Residential	1.021	55.0	8.6	1.128	60.8	9.5	1.186	63.9	10.0
Com./Instit.	1.021	17.3	5.3	1.128	19.1	5.9	1.186	20.0	6.2
Industrial	1.024	11.1	3.5	1.144	12.4	3.9	1.264	13.7	4.3

The county growth factors were also used to project emission for each grid.

3.5.2.2 Open Burning

Open burning projected emissions have been calculated for residential, C/I, and industrial categories combined. The OBERS, Series E county population projections and Owensboro UTS projections were used to establish growth factors for the areas outside the Owensboro city limits. Open burning is prohibited within the city limits. The necessary population projections are shown below.

Owensboro and Daviess County Population Projections

Year	OBERS County Projections	-	Owensboro UTS Projections	=	Remainder of County
1971	78,898				
1972			57,559		
1974	84,300*		59,627*		24,673 (1.000)
1975	86,100*		60,660*		25,440 (1.031)
1980	95,100*		65,830*		29,270 (1.186)
1985	100,000		71,000*		29,000 (1.175)
1995			81,337		

---

*Interpolation

The resulting projected emissions for the non-urban area are shown below.

Daviess County Projected Open Burning Emissions (tons)

	1975			1980			1985	
EGF	TSP	SO_2	EGF	TSP	SO_2	EGF	TSP	SO_2
1.031	56.6	3.3	1.186	65.0	3.8	1.175	64.4	3.8

3.5.3 Henderson County

3.5.3.1 Incineration

Projections of incineration emissions have been made for residential, commercial/institutional, and industrial subcategories. Residential and C/I emissions have been projected using the population growth factors developed in Section 3.2.3.1. Industrial incineration emissions have been projected using the industrial growth factors developed in Section 3.2.3.3. The resulting county projected emissions are shown below.

Henderson County Projected Incineration Emissions (tons)

	1975			1980			1985		
Category	EGF	TSP	SO_2	EGF	TSP	SO_2	EGF	TSP	SO_2
Residential	1.013	24.5	3.8	1.082	26.2	4.1	1.142	27.6	4.3
Com/Instit.	1.013	7.7	2.3	1.082	8.2	2.5	1.142	8.7	2.6
Industrial	1.016	2.5	1.2	1.099	2.7	1.3	1.177	2.9	1.4

3.5.3.2 Open Burning

Open burning projected emissions have been calculated for residential, C/I, and industrial subcategories combined. Population growth factors for the Evansville SMSA from OBERS, Series E were used to project open burning emissions for the non-urban area of Henderson County (see below). Open burning is prohibited within the Henderson city limits, and emissions were assumed to be zero. The county projected emissions are shown below.

Henderson County* Projected Open Burning Emissions (tons)

1975			1980			1985		
EGF	TSP	SO_2	EGF	TSP	SO_2	EGF	TSP	SO_2
1.017	18.3	1.1	1.099	19.8	1.2	1.162	20.9	1.3

---

*Census tracts 207, 208, and 209

Evansville SMSA Series E OBERS Population Projections

1971	234,700	
1974*	246,967	(1.000)
1975*	251,056	(1.017)
1980	271,500	(1.099)
1985	287,000	(1.162)

---

*Interpolation

3.6 Fugitive Dust Sources

3.6.1 Vanderburgh County

Limited data was available to project activity of fugitive dust sources in Vanderburgh County. Two categories where potential activity changes could be significant were investigated. These categories were paved road VMT and agricultural tilling. The other fugitive dust categories are assumed to have the same level of emissions in the projection years.

3.6.1.1 Agricultural Tilling

In an attempt to project future agricultural activity in the county, historical statistics were reviewed. These are presented below.

Vanderburgh County
Harvested Crop Acreage for Selected Years[1]

Crop	1960	1965	1970	1973	1974	1975
Corn	31,000	32,700	35,700	31,300	32,800	34,200
Beans	23,200	22,800	22,800	33,800	29,300	26,700
Wheat	10,000	8,700	6,000	8,400	14,600	10,800
Oats	900	200	300	300	300	300
Hay	5,800	4,300	3,700	4,300	3,300	3,300
TOTAL	70,900	68,700	68,500	78,100	80,300	75,300

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[1] Source: U.S. Dept. of Agriculture, Statistical Reporting Service, Purdue University

Although no year-by-year trend is indicated, overall harvested acreage has increased in the 1970's relative to the 60's. Since no trend can be predicted from the 1970's data, agricultural tilling emissions are assumed to be the same for the AQMA projection years.

3.6.1.2 Highway Vehicles - Paved Roads

Dust entrained from paved roads has been projected increased directly with VMT increases in the county. The following projected emissions assume no significant change in roadway maintenance procedures which would mitigate dust, emissions. The VMT growth factors were developed in Section 3.3.1.

Vanderburgh County
Projected Fugitive Dust Reentrainment from Paved Roads

1975		1980		1985	
EGF	TSP	EGF	TSP	EGF	TSP
1.000	1104 tons	1.032	1139 tons	1.065	1176 tons

3.6.2 Daviess County

No fugitive dust projections activity was available for Daviess County except VMT. The remaining fugitive dust categories are, therefore, projected to have the same level and areal distribution of emissions.

The projected VMT was described in Section 3.3.2. The VMT growth factors were used to project fugitive dust emissions from travel over paved roads. The county projections are shown below.

Daviess County

Projected Fugitive Dust Reentrainment from Paved Roads

1975		1980		1985	
EGF	TSP	EGF	TSP	EGF	TSP
1.034	543 tons	1.203	632 tons	1.372	720 tons

3.6.3 Henderson County

Projections fugitive dust activity were available only for vehicle miles traveled on paved roads. The other categories are projected to have the same magnitude and distribution of dust emissions over the 10 year planning period.

The projected dust reentrainment from paved roads has been estimated by using the VMT growth factors developed in Section 3.3.3. The county projected emissions are shown below.

Henderson County

Projected Fugitive Dust Reentrainment from Paved Roads

1975		1980		1985	
EGF	TSP	EGF	TSP	EGF	TSP
1.032	356 tons	1.190	411 tons	1.349	466 tons

3.7 Miscellaneous Area Sources

3.7.1 Vanderburgh County

The only miscellaneous category which can be expected to increase significantly is structural fires. Emissions from this category have been projected to increase according to population increases in the county (see Section 3.2.1). The county projected particulate emissions are shown below.

Vanderburgh County
Projected Structural Fires Emissions

1975		1980		1985	
EGF	TSP	EGF	TSP	EGF	TSP
1.006	56.4 tons	1.053	59.1 tons	1.063	59.6 tons

3.7.2 Daviess County

The only miscellaneous category which has been projected to change is structural fires. Emissions from process non-point sources are expected to remain at the same level as the base year.

Structural fires have been projected to increase according to population growth in the county. The population growth factors were developed in Section 3.2.2. The projected particulate emissions are shown below.

Daviess County

Projected Structural Fires Emissions

1975		1980		1985	
EGF	TSP	EGF	TSP	EGF	TSP
1.021	51.7 tons	1.128	57.1 tons	1.186	60.0 tons

3.7.3 Henderson County

The only miscellaneous category which can be expected to increase is structural fires. It has been assumed that process loss sources will remain at the same level of activity.

Structural fires emissions have been projected to increase proportional to population growth in the county. County population growth factors were computed in Section 3.2.3. The resulting projected particulate emissions are shown below.

Henderson County

Projected Structural Fires Emissions

1975		1980		1985	
EGF	TSP	EGF	TSP	EGF	TSP
1.013	16.6 tons	1.082	17.7 tons	1.142	18.7 tons

4.0 CDM CONVERSION

This section describes the methods used to translate area and point source computed emissions into input format for the Climatological Dispersion Model (CDM).[1] Computer card decks, coding sheets and related documentation were submitted to the regional office under a separate cover.

4.1 Point Sources

Point source stack-by-stack projections for Vanderburgh, Henderson, and Daviess Counties were converted to CDM input format using stack parameters and UTM coordinates from updated EIS printouts supplied by the state agencies.

4.2 Area Sources

The area source gridded emissions for each county were converted to CDM format as follows. First, a CDM grid system for the three counties was chosen (see Figures 4-1 to 4-5). As described in Chapter 2.0, the Daviess County grid was also chosen to serve as the CDM grid (see Figures 2-5 and 2-6). The CDM grid for Henderson and Vanderburgh Counties was chosen so as not to violate the CDM dimension statement for the number of "basic" grids, 2500. Therefore, the basic grid size chosen was 2 x 2 km. The resulting 143 grid-system consists of the following:

Vanderburgh County: 44-4 square km grids, 8-16 square km grids, and 5-64 square km grids. A total of 57 grids.

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[1] Busse, Adrian D., and Zimmerman, John R., User's Guide for the Climatological Dispersion Model, EPA-R4-73-024, Environmental Protection Agency, Research Triangle Park, NC, December, 1973.

Daviess County: 1-4 square km grid, 4-4 square km grids, 10-16 square km grids, 4-36 square km grids, and 6-144 square km grids. A total of 25 grids.

Henderson County: 32-4 square km grids, 21-16 square km grids, 6-64 square km grids, and 2-144 square km grids. A total of 61 grids.

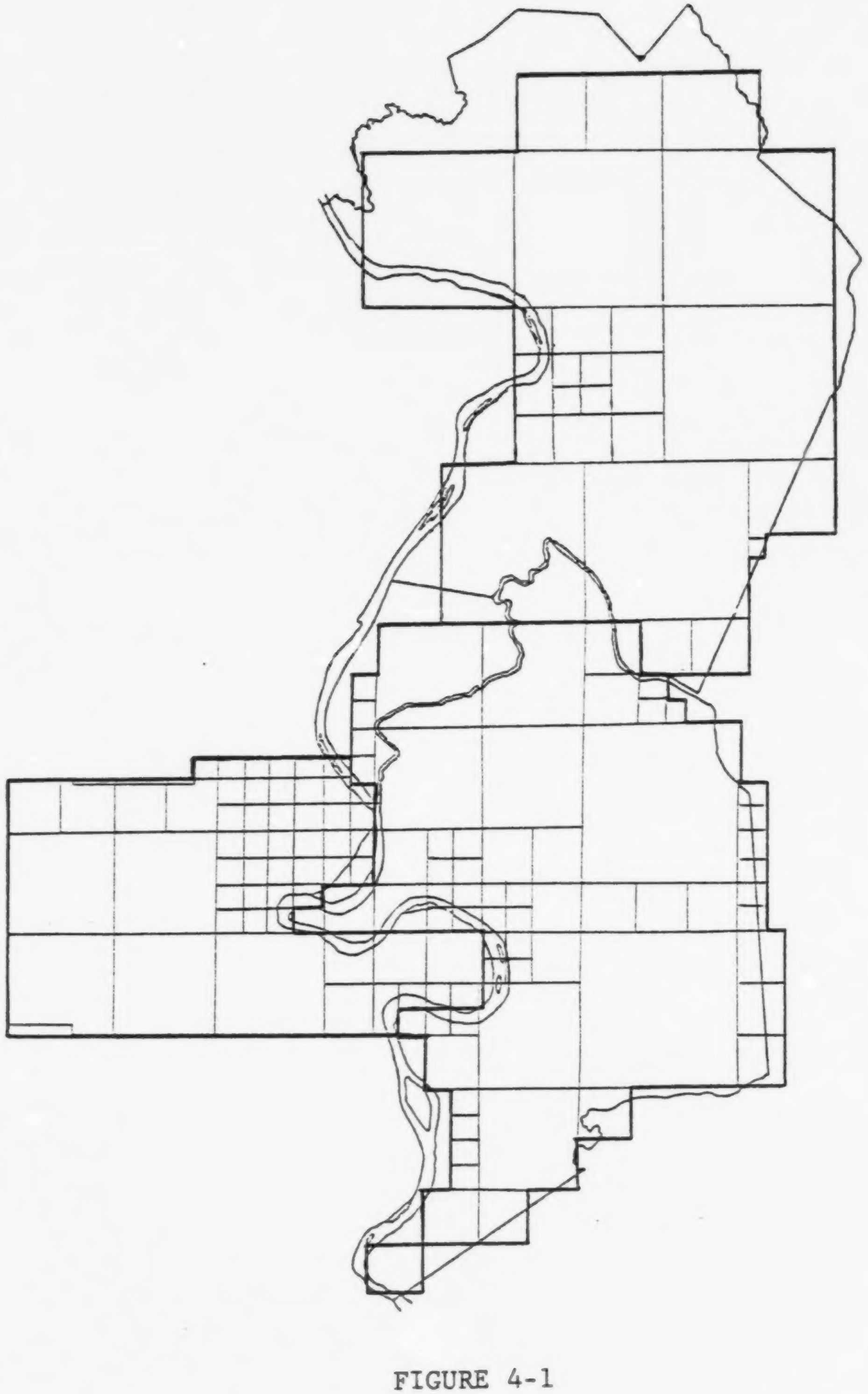
The next step was to translate the natural grids for each county into the CDM grid system. This involved measuring apportioning factors for Vanderburgh and Henderson Counties. No apportioning factors were required for Daviess County.

Finally, the 1974 emissions for each CDM grid were calculated by (1) adding up the natural grid totals from each area source category, and (2) applying the above described apportioning factors. Since the 1975 projected inventory was nearly identical to the 1974 inventory, only the 1980 and 1985 projected inventories were converted to CDM format.

Annual emissions in tons for each CDM grid were converted to grams per second by dividing by 34.7. The plume height for each CDM grid was set at 12.0 meters.

OVERALL CDM GRID SYSTEM

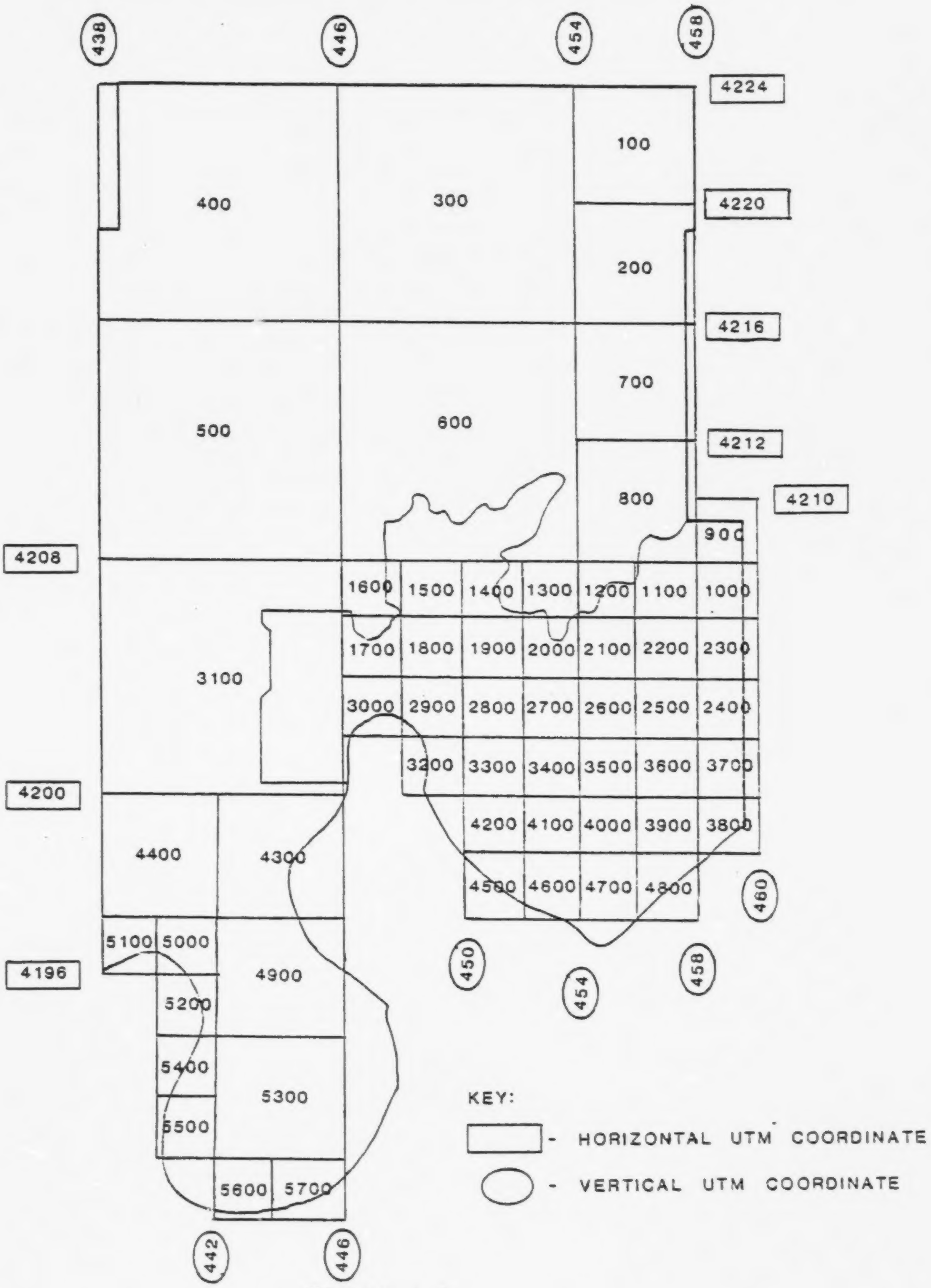
VANDERBURGH-HENDERSON-DAVIESS COUNTIES



02-1895-1

FIGURE 4-1

CDM GRIDS
VANDERBURGH COUNTY, INDIANA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1600
1500
1400
1300
1200
1100
1000
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1800
1900
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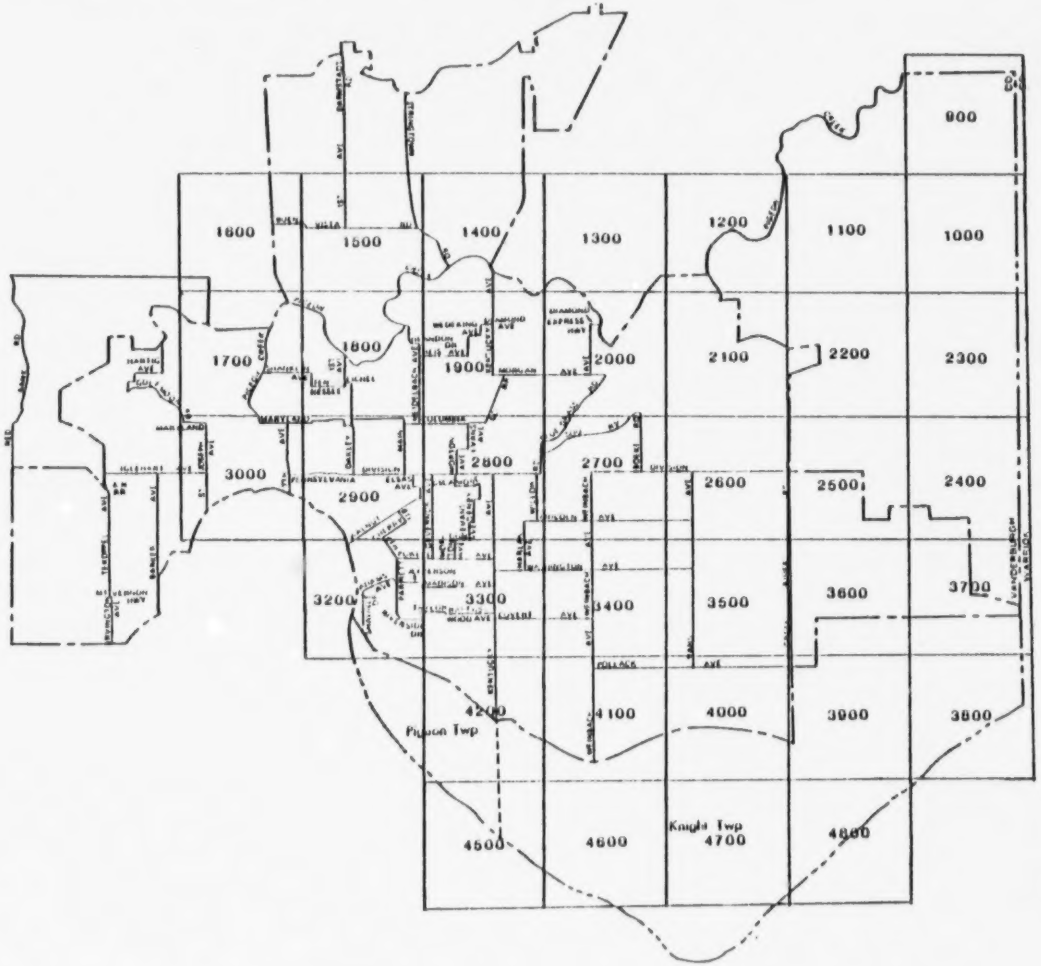
4100
4000
3900
3800
4500
4600
4700
4800
460
5100
5000
4900
4196
450
454
458
5200
5400
5300
5500
5600
5700
442
446
KEY:
- HORIZONTAL UTM COORDINATE
- VERTICAL UTM COORDINATE

FIGURE 4-2

02-1709-1

CDM GRIDS
VANDERBURGH COUNTY, INDIANA
INSET - EVANSVILLE AND VICINITY



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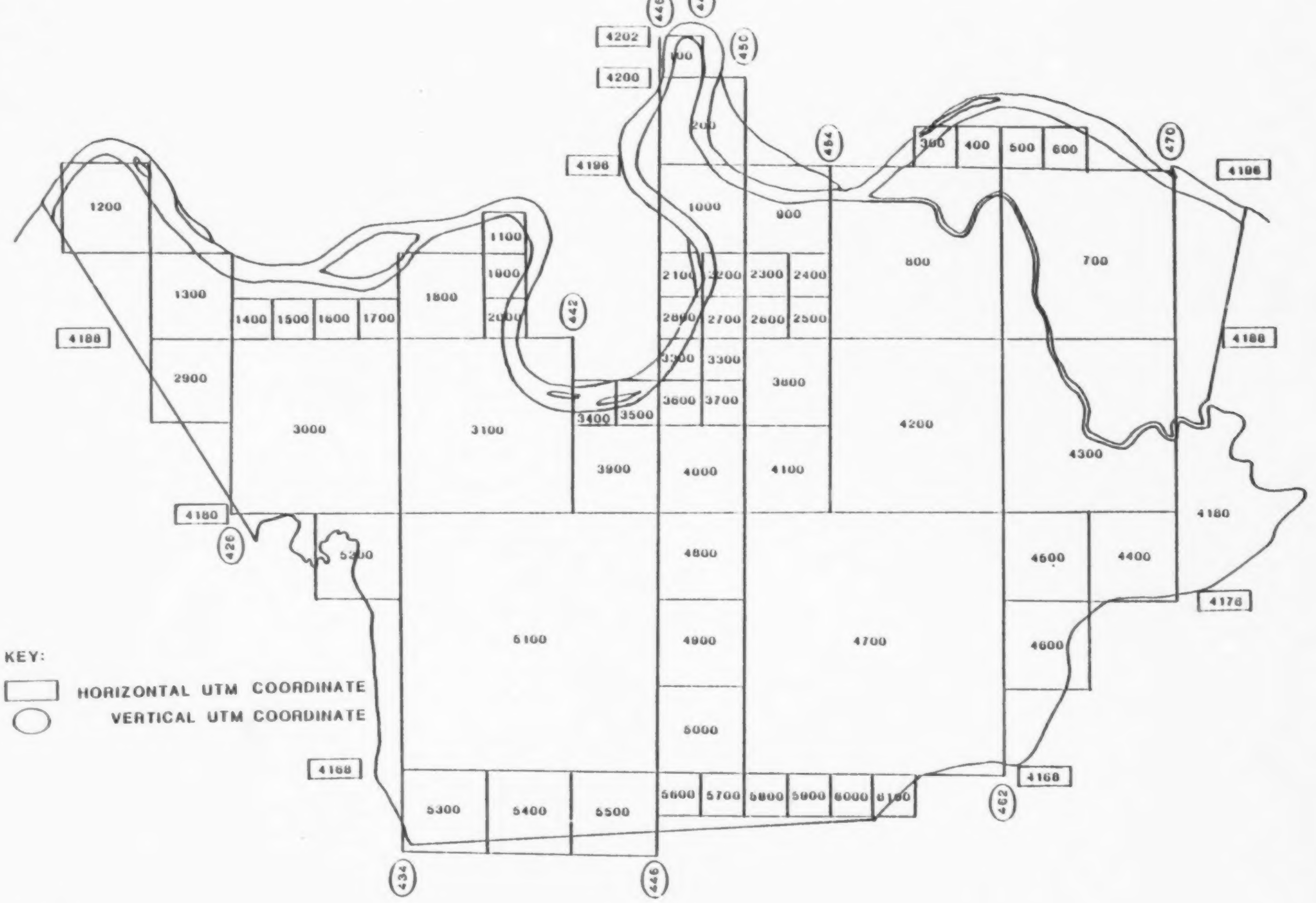
2900
3000
3200
3300
3400
3500
3600
3700
3800
3900
4000
4100
4200
4500
4600
4700
4800
Knight Twp
Pigeon Twp
VANDERBURGH
MARYLAND
PENNSYLVANIA
DIVISION
COLUMBIA
POLLACK

FIGURE 4-3

CDM GRIDS
HENDERSON COUNTY, KENTUCKY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3900
4000
4100
4300
4180
5200
4800
4600
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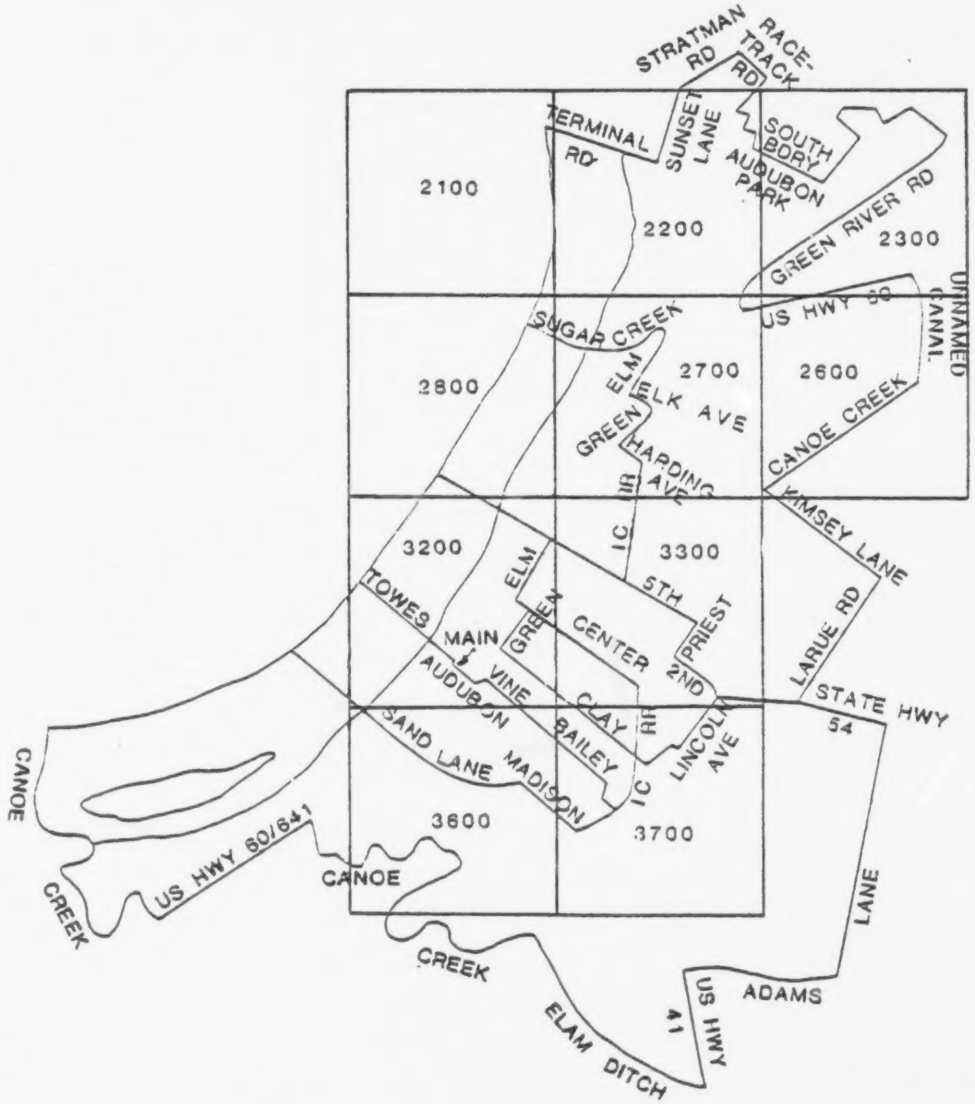
4168
5300
5400
5500
5600
5700
5800
5900
6000
6100
4168
426
434
446
462
KEY:
HORIZONTAL UTM COORDINATE
VERTICAL UTM COORDINATE

02-1710-2

FIGURE 4-4

INSET - HENDERSON AREA CDM GRIDS
HENDERSON COUNTY, KENTUCKY



STRATMAN RD
RACE-TRACK RD
TERMINAL RD
SUNSET LANE
SOUTH BDRY
AUDUBON PARK
GREEN RIVER RD
2100
2200
2300
UNNAMED CANAL
US HWY 60
SUGAR CREEK
ELM
2700
2600
2800
ELK AVE
GREEN
HARDING AVE
CANOE CREEK
KIMSEY LANE
IC RR
3200
3300
ELM
5TH
TOWES
MAIN
GREEN
CENTER
PRIEST
2ND
LARUE RD
AUDUBON
VINE
CLAY
STATE HWY 54
SAND LANE
MADISON
BAILEY
IC RR
LINCOLN AVE
CANOE CREEK
US HWY 60/641
3600
3700
CANOE
CREEK
LANE
ADAMS
US HWY 41
ELAM DITCH

FIGURE 4-5

APPENDICES

APPENDIX A

POPULATION AND EMPLOYMENT DATA

TABLE A-1. 1974 NATURAL GRID POPULATION - VANDERBURGH COUNTY

Grid	Population
1	3005
2	6462
3	6307
4	2976
5	2716
6	2347
7	2765
8	3681
9	8358
10	4999
11	3956
12	3484
13	3002
14	2716
15	3487
16	3230
17	1909
18	962
19	3270
20	2768
21	2768
22	1901
23	3448
24	4263
25	3084
26	3449
27	2298
28	2827
29	1795
30	5755

(Cont'd)

TABLE A-1 (Cont'd)

Grid	Population
31	3732
32	2352
33	3599
34	4738
35	2517
36	4737
37	7844
38	7863
39	2844
101	3477
102	9343
103	1586
104	5824
105	6327
106	609
107	2143
TOTAL	173,464

TABLE A-2. 1970 NATURAL GRID EMPLOYMENT - VANDERBURGH COUNTY

Grid	Construction Employment	Manufacturing Employment	Total Employment
001	51	546	1,413
002	78	586	2,251
003	89	640	2,486
004	46	298	1,295
005	17	203	1,067
006	47	204	944
007	66	309	1,168
008	97	484	1,695
009	179	945	3,457
010	58	565	1,776
011	90	439	1,274
012	102	460	1,454
013	118	407	1,459
014	35	291	949
015	42	264	1,139
016	29	154	896
017	36	233	749
018	7	57	348
019	36	371	858
020	52	427	1,289
021	51	411	987
022	86	208	761
023	78	491	1,410
024	67	745	2,016
025	39	419	1,046
026	27	554	1,221
027	36	259	692
028	43	383	1,072
029	24	238	596

(Cont'd)

TABLE A-2 (Cont'd)

Grid	Construction Employment	Manufacturing Employment	Total Employment
030	81	724	2,432
031	124	525	1,322
032	87	396	936
033	70	573	1,559
034	57	693	1,749
035	50	349	973
036	142	646	1,725
037	165	634	2,749
038	80	623	2,884
039	33	271	783
101	59	271	912
102	119	1,159	3,272
103	35	202	579
104	175	799	2,234
105	225	822	2,423
106	30	166	545
107	96	492	1,597
Total	3,354	20,946	66,442

TABLE A-3. 1974 GRID POPULATION - DAVIESS COUNTY

Grid	Population
100	851
200	851
300	851
400	3,403
500	3,403
600	3,403
701	799
702	3,846
703	473
704	651
705	6,447
706	7,424
707	8,196
708	8,079
709	8,232
710	808
711	11,330
712	1,723
800	3,403
900	851
1000	3,403
1100	3,403
1200	378
1300	378
1400	95

TABLE A-4. 1974 NATURAL GRID INDUSTRIAL EMPLOYMENT - DAVIESS COUNTY

Grid	Employment
100	32
200	32
300	32
400	129
500	129
600	129
701	462
702	41
703	24
704	198
705	778
706	3
707	2,082
708	327
709	47
710	395
711	2,455
712	24
800	129
900	32
1000	129
1100	129
1200	14
1300	14
1400	4

TABLE A-5. 1974 NATURAL GRID POPULATION - HENDERSON COUNTY

Grid	Population
201	2,920
202	2,973
203	3,109
204	3,665
205	3,317
206N	3,854
206S	2,317
207N	3,082
207S	3,082
208	3,110
209N	3,327
209S	3,327
TOTAL	38,083

APPENDIX B

EXCERPT FROM
GUIDELINES FOR AIR QUALITY MAINTENANCE PLANNING AND ANALYSIS, VOL. 7, PROJECTING COUNTY EMISSIONS

EXCERPT FROM VOLUME 7: PROJECTING COUNTY EMISSIONS, GUIDELINES FOR AIR QUALITY MAINTENANCE PLANNING AND ANALYSIS, PAGES 20-23

(3) The Effect of New Source Performance Standards on Forecasted Emissions

The value for the future equivalent control efficiency to be "plugged into" the emissions equation is usually a function of the laws and regulations already agreed upon by the State agencies and EPA. There are, however, some industrial processes that are now, or are likely to be, subject to Federal New Source Performance Standards (NSPS). Some NSPS became effective in 1971 while others will be implemented in 1975. Still others will probably be in effect by 1980 or by 1985. Preliminary estimates of the emission reductions resulting from these promulgated and proposed NSPS have been tabulated by EPA for use in Air Quality Maintenance emission projections and can be obtained from the AQMA representative in each EPA Regional Office. This reference specifies either the required control efficiency (percent removal of uncontrolled emissions) or the maximum amount of pollutant allowed per unit of activity for each process likely to be affected by NSPS between 1974 and 1985.

Federal NSPS apply to the following industrial activities:

(a) New equipment installed in an existing facility
(b) Replacement of obsolete equipment within an existing facility
(c) All equipment in a new facility

Federal NSPS do not apply to utilization of idle capacity, however.

Thus, three different situations can exist for an industrial process subject to NSPS:

(a) The entire facility is subject to NSPS
(b) Part of the production is subject to NSPS and no other laws affect the remaining production
(c) One part of the production is subject to NSPS and the remainder is subject to a local agency regulation

Exhibit 1 depicts plan information for a source that is currently subject to a local regulation or compliance schedule and also will be subject to an NSPS in 1980. The objective of this example is to show, in general, how to estimate 1985 emissions when one portion of the 1985 source production will be subject to an NSPS and the remainder will still be subject to the local regulation. This method is also valid when the NSPS is the sole control regulation affecting the industrial process. Before constructing a graph similar to Exhibit 1, the following data must be collected for the point source under investigation:

(a) Production rate for the base year (obtained via interviews)
(b) Design capacity (obtained via interviews)

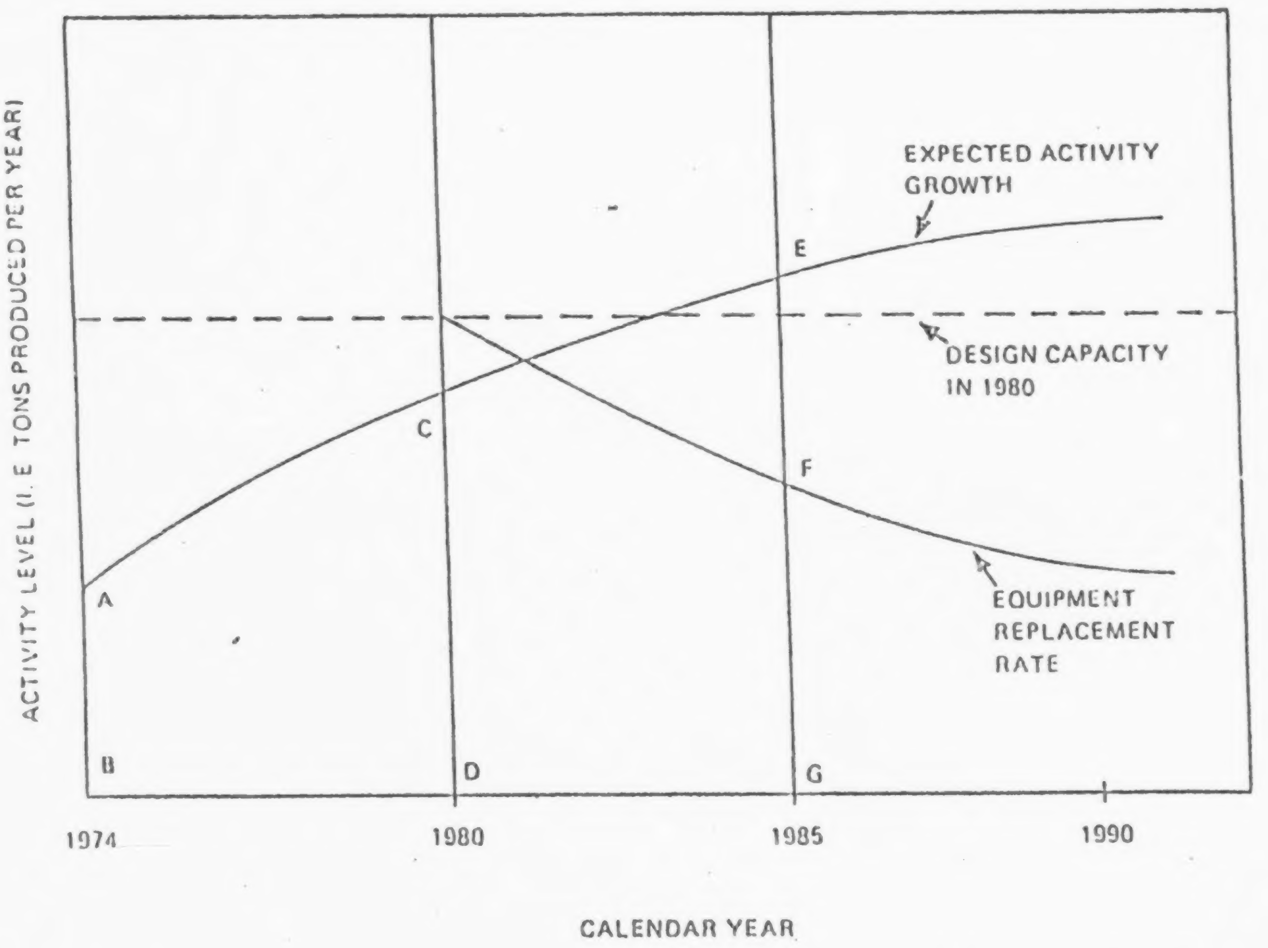


EXHIBIT 1

SAMPLE PLANT PROJECTIONS

APPENDIX C
INPUT LISTING OF GROWTH SURVEY AND OTHER DATA FOR VANDERBURGH COUNTY POINT SOURCE PROJECTIONS

(Submitted to EPA
Regional Office Under
Separate Cover)